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Original Articles.

NOMOGRAPHIC CHARTS FOR THE CALCULATION OF THE METABOLIC RATE BY THE GASOMETER METHOD.*

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CHOICE OF APPARATUS.

As a result of the greatly increased interest in the basal metabolic rate as an aid in diagnosis in thyroid disorders, the question of the selection of the best apparatus for the determination in clinical work naturally arises. That apparatus is preferable which will determine the metabolic rate with the minimum of work and with sufficient accuracy for diagnostic purposes. The general idea is prevalent that a "metabolic rate approximately accurate and sufficiently good for clinical work" can be obtained by the use of some simple, apparently automatic apparatus run by an untrained person. Unfortunately, no such apparatus at present exists and it is highly improbable that such can be devised, because in this laboratory test we are dealing with gases and not with visible, ponderable matter (in the popular sense), and in consequence every step in the technic must be carried out so that errors will not oc-

cur in the determination of the volume and composition of the expired air or of the amount of oxygen gas absorbed by the patient. For these reasons the apparatus must be accurate and the technician must be especially trained in the proper handling of gases. We have pointed out many times that the basal metabolic rate will fall into great discredit and the entire question of variation in the rates in various diseases be utterly confused by careless and improper technic in their determination.

There are only two types of apparatus, the accuracy of which has been sufficiently controlled up to the present time by scientific experimentation to justify their consideration for clinical work. These are the Benedict closed-circuit system, and the open-circuit system, known as the Tissot or the gasometer method. Either type of apparatus, when properly constructed and properly run, will give accurate results. For the reasons later enumerated, we have been using, for the last four years, the gasometer or open-circuit system, which has proved most satisfactory and equally adaptable in our main laboratory where, with the aid of several technicians, we are carrying out thirty-five tests daily, and in a small subsidiary laboratory with one technician, who is able to do five complete tests a day.

In response to repeated requests as to the reasons for our choice of apparatus for clinical work, we give below the various points which, after consideration, led us to adopt the gasometer or open-circuit system. On the other hand, we do not wish to imply that excellent results cannot be obtained by a properly con-

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structed and skillfully run closed-circuit apparatus; and we wish to reiterate that the determination of accurate basal metabolic rates is not so much a question of which of these two forms of apparatus is used as it is of careful painstaking attention to the details of technique peculiar to each type of apparatus. Further, we desire to emphasize that both forms require far more care and accuracy in manipulation than do the "clinical tests" of various kinds in general diagnostic use and that the clinician planning to undertake metabolic rate determinations must be resigned to the expense and trouble incident thereto. With these reservations, the reasons for selecting the gasometer method for our laboratory are, then, as follows:

1. With the gasometer method the patient always breathes fresh out-door air, while in the closed-circuit apparatus, to prevent re-breathing the expired air of previous patients, it is necessary to rinse the entire apparatus several times with room air; if this is not invariably and carefully done, not only is the liability to air-borne infection increased, but also the contained air becomes most disagreeable.

2. The danger of transmitting pulmonary infection is obviated in the gasometer method since the inspired air never passes over tubing through which the expired air has passed, and the parts that are in contact with the patient can be cleaned readily. We consider the possibility of respiratory infection a serious criticism of the closed-circuit system.

3. In the gasometer method either a mask or a mouthpiece with nose clip may be used. With the closed-circuit system Benedict does not advise the use of a mask. Those who had experience with the army gas mask realize the troops' dislike for the mouthpiece: many hours of practice and drill were necessary before most of the men learned to breathe with ease through the mouthpiece and, in fact, there were some who never could use it properly. Also, from the point of view of the technician, the mask is preferable, especially when patients with dirty and infected mouths must be dealt with. Moreover, patients almost invariably express a very decided preference for the mask.

4. The loss of a given volume of air during an experiment with the gasometer method causes an error about one-twentieth as great as the loss of a similar volume from a closed-circuit system. This is a vital consideration since we have found that by far the most frequent cause of experimental error is a leak between the patient and the apparatus; we estimate that an error of appreciable magnitude occurs from this source in about 1 per cent. of our routine tests and is practically the only laboratory error that cannot be consistently avoided. In a closed-circuit system, any leak affects directly the oxygen reading, while with the gasometer method it means only the error caused by the loss of the 5 per cent.

oxygen that had been absorbed out of the air that was lost. Thus a leak of 100 cc. of the expired air during a ten-minute period with the gasometer method would cause an error of only 5 cc. in the calculation of the oxygen absorbed, or 0.5 cc. a minute, which is negligible. On the other hand, a leak of 100 cc. with the closed-circuit system would mean the loss of 100 cc. of oxygen, or 10 cc. per minute, an error which is not negligible. Errors of material magnitude in the estimation of the basal metabolic rate are therefore much more likely to occur frequently with the closed-circuit system than with the gasometer method.

5. Constant attention must be directed to keeping a closed-circuit system with its many connections absolutely air-tight, a procedure that involves many mechanical difficulties. On the other hand, with the gasometer, there are practically no mechanical difficulties, and therefore, it is particularly suitable for a girl to run.

6. The experimental period with the gasometer method can be started or ended without appreciable error at any phase of the respiratory cycle. In the closed-circuit system the experimental period must begin and end exactly at the bottom of a normal expiration; if this is not done with exactness, a large error results which can only be allowed for by a correction obtained from a kymographic record of the respiratory volume made for the entire experimental period.

7. A change in the character of the respiration during an experiment usually makes little or no difference with the gasometer method, while it materially affects the reading obtained by the closed-circuit system because of the inability to start and end the experiment with the same amount of air in the lungs. Also the swallowing of air or its eructation from the stomach may cause an error in a closed-circuit system.

8. The original difficulties from the burning out of the electric motor and the ignition or explosion of the oxygen-rich mixture have been decreased in the later models of the Benedict portable closed-circuit apparatus; however, the noise and vibration of the motor are annoying to many patients. The air pump is often of too small capacity and under conditions of actual use does not drive the air in sufficient volume through the soda lime to absorb completely the carbon dioxide. These difficulties are, of course, not present in the gasometer method.

9. The complete and rapid absorption of carbon dioxide by soda lime in the closed-circuit system is essential; otherwise, a serious error will result in the measurement of the oxygen absorbed by the patient and moreover, the unabsorbed carbon dioxide in the inspired air will cause a deepening of the respirations with a corresponding departure of the expiratory

base line from that obtained at the beginning of the experimental period. The direction of the first error due to the volume of the non-absorbed carbon dioxide by decreasing the apparent amount of oxygen absorbed tends to make the metabolic rate too low. The direction of the second error due to the increase in the respiratory volume caused by the effect of the accumulated carbon dioxide on the respiratory center tends to make the metabolic rate too high because a greater proportion of the air of the closed-circuit system will, at the end of an expiration, be in the lungs of the subject instead of in the measuring apparatus. Therefore, in many instances, these two opposing errors will balance each other and an approximately correct answer be determined accidentally; on the other hand, one error may be much larger than the other, depending on the exact manner in which the particular individual adjusts his respiratory mechanism to the increased carbon dioxide tension in the inspired air. Because a normal result is obtained on normal subjects does not necessarily mean that there are not fundamental errors in the use of the apparatus. These errors are often overlooked, because in the normals studied the two opposing errors happen to balance; furthermore, triplicate determinations obtained by using three inclusive time periods according to the method suggested by Emmes, may check and therefore the results are accepted as correct whereas, in fact, the two opposing errors only give a very rough approximation of the true determination. An advantage of the gasometer method with duplicate gas analysis is that no such balancing of errors is possible, and the technician is obviously warned that a mistake has occurred. In patients having hyperthyroidism, the carbon dioxide eliminated in a unit of time may be twice that of a normal person. Therefore soda-lime absorbers capable of taking care of the carbon dioxide as fast as eliminated by a normal person may not do so for a patient with an increased metabolic rate. Patients often complain of dyspnea as a result of incomplete carbon dioxide absorption, and are unable to continue the experiment more than five minutes.

It is often difficult to obtain good soda lime that is neither too coarse nor too fine and which has rapid carbon dioxide absorbing power. The preparation and filling of the soda lime bottles, which must be done frequently to avoid these errors is a dirty and time-consuming task.

10. For hospital work the gasometer method meets the requirement of portability since the apparatus can be wheeled to the patient's bedside.

11. The gasometer method lends itself readily to the use of duplicate readings, duplicate analyses, and mathematical checking.

12. The only advantage of the gasom-

eter method is the necessity for gas analyses. Furthermore, the analyses must be made in duplicate, and by a technician who thoroughly understands the use of a Haldane gas analysis apparatus. However, we have not found it difficult to teach high school graduates, in from four to eight weeks, to use a Haldane apparatus accurately; a trained laboratory worker can learn its use in one or two weeks. The principle of a Haldane is very simple, although it takes some time to acquire the manual dexterity necessary to use it properly. While we do not wish to minimize the difficulties of gas analysis, we believe that they have been magnified and do not outweigh the various advantages of the gasometer method just enumerated. For a detailed exposition of the technic of basal metabolic rate determinations by the gasometer method the reader is referred to the laboratory manual by Boothby and Sandiford.

ABRIDGED TABLES AND CALCULATION FORM.

Special detailed tables for the calculation of the metabolic rate by the gasometer method have been published by Boothby and Sandiford. However, for clinical work, their tables and method of calculation can be considerably condensed without appreciable loss in accuracy. Accordingly we are presenting abridged tables and a series of nomographic charts by which the metabolic rate can be calculated by a graphic method in less than five minutes. An abridged log factor table for reducing gas volumes to standard temperature and pressure dry is also included so that, if preferred, the calculation may be carried out first by logarithms and the result checked by the graphic charts. In our laboratory we prefer the combined method, since checking the results by a method entirely different from the original computation precludes the possibility of an error in calculation. For this purpose we have arranged a "calculation form" adapted for rapid checking of each step of the mathematical calculation by the charts. The condensed tables and calculation form are given at the end of this paper and are self-explanatory.

CONSTRUCTION OF THE NOMOGRAPHIC CHARTS.

There are many mathematical procedures for which it is possible to construct one or another form of nomographic chart to meet the needs of the various types of equations involved. The charts used in the calculation of the metabolic rate by the gasometer method of indirect calorimetry fortunately embrace four of the most common and most widely applicable equations. The method of construction of these charts is given in order to aid those who may desire to construct similar charts to solve a frequently used equation in their own work; in this description we shall follow closely the exposition of the subject given by Professor

Lipka in his book, "Graphical and Mechanical Computation," although we shall express ourselves in a less technical manner. The reader is referred to Lipka's excellent work for a complete mathematical exposition of the subject.

The simplest form of nomographic or alignment chart consists of a series of three parallel scales representing the component parts of an equation of three variables $f(u, v, w) = 0$. The scales are constructed in such a manner that a straight line (index line) cutting the three scales in values of u , v , and w satisfies the equation. In other words, the nomographic chart accomplishes the same purpose as a slide rule, only it solves the equation graphically.

In the construction of a chart its general plan must first be determined; this involves the consideration of the best form of equation to solve the problem, taken in conjunction with the size of the chart desired; the latter involves also the question of whether the chart is to be used in the original size or is to be reduced and on the accuracy or number of significant figures with which it is desired to express each function.

To obtain the desired length of the scale with the appropriate number of graduations, the proper modulus for each scale must be chosen. The scale modulus (designated by m) is that number of inches (or centimeters) which represents the length of the unit segment selected for the unit value of the variable to be plotted. The equation of the scale, $x = mf(u)$ is the equation by which the position of the different values of u on the scale is determined. For the calculation of a uniform scale where $f(u) = u$, the scale equation is $x = mu$ where m represents the length of unit division of the scale and as all the divisions are uniform, they may then be laid off by dividers.

In the case of a nonuniform or logarithmic scale, for example, when $f(u) = \log u$, the scale equation is $x = m \log u$ where m is the length selected to represent the entire logarithmic scale between 1 and 10; to construct a logarithmic scale all the main intermediate points must be determined by calculation or plotted by the use of a standard logarithmic scale.

The selection of the moduli to represent the unit lengths of the variables may be made arbitrarily for all but one of the variables of the equation to meet the requirements of the size of the chart and degree of accuracy (number of significant figures) desired; however, the modulus for the scale of the remaining variable of the equation is dependent on those already selected. For example, in an equation of three variables of the form $f_1(u) + f_2(v) - f_3(w)$ the moduli m_u and m_v are chosen arbitrarily, while m_w is thereby fixed and determined by the formula $m_w = \frac{m_u + m_v}{m_u m_v}$.

Likewise the distance between the u and v

scales may be selected arbitrarily; the position of the w scale between these two is thereby fixed and determined by the ratio of the moduli as follows: the distance between the u and v scales is to the distance between the w and v scales as m_u is to m_w . For example, if the distance between the u and v scales is selected as 10 inches and the modulus of the u scale is 10 and of the v scale is 20, then the distance of the w scale from the u scale is $10 \times 10/30 = 3.33$, and the distance of the w scale from the v scale is $10 \times 20/30 = 6.67$. Caution must be taken not to get the u and v scales too near together, which would give an uncertain and inaccurate intersection on the w scale. Judgment should be exercised in the choice of m_u and m_v , because if m_u is many times larger than m_v , or vice versa, the w scale will have to be drawn too near the u or v scale. It is best to try to select the moduli so that the third scale may be erected not far from midway between the other two scales. If $m_u = m_v$, then the w scale is erected exactly half way between the u and v scales.

A nomographic chart of three parallel scales solves equations of the general form $f_1(u) \pm f_2(v) = f_3(w)$, or $f_1(u) \times f_2(v) = f_3(w)$, or $f_1(u)/f_2(v) = f_3(w)$; these equations are similar because the two latter may be brought into the form of the first by taking logarithms of both sides of the equation. Of the equations involved in the calculation of the metabolic rate, three, namely: (1) $H^{0.725} \times W^{0.725} \times 0.007184 = S$; (2) $(C-N)/N = BMR$; and (3) $S \times C \times 24 = T C$, come under the form of this general equation and can, therefore, be solved by a three parallel line chart. In these equations H represents the standing height in centimeters; W , the weight in kilograms; S , the surface area in square meters; C , the basal calories per square meter per hour found experimentally; N , the normal basal calories per square meter per hour; BMR , the basal metabolic rate; and $T C$ the total basal calories for 24 hours.

To construct a nomographic chart to solve the Du Bois formula for surface area: $H^{0.725} \times W^{0.725} \times 0.007184 = S$ take the logs of both sides of the equation: $0.725 \log H + 0.425 \log W + \log 0.007184 = \log S$, thus converting the equation into the first form of the general equations given above.

Arrange the data in tabular form (Table I) as follows: Under scale write the variables in the order given in the equation for the determination of the surface area; decide the limits within which the variables are to be used, which in this case are a height of 220 cm. and a weight of 200 kg. for the maximum and a height of 75 cm. and a weight of 15 kg. for the minimum; find the logs of the limits and subtract the two. In the next column are placed the moduli chosen for the various scales; if the length of the paper is chosen

TABLE I.

SCALE	LIMITS	LOG LIMITS	MODULUS*	SCALE EQUATION	LENGTH OF SCALE
f_1 (H)	220 cm. 75 difference	2.3424 1.8751 .4673	$m_1=40''$	$x=m_1 f_1 (H)$ $x=40 \times (0.725 \log H)$ $x=29 \log H$	$29 \times 0.4673=13.55''$
f_1 (W)	200 kg. 15 1.1249	2.3010 1.1761 1.1249	$m_1=40''$	$y=m_1 f_1 (W)$ $y=40 \times (0.425 \log W)$ $y=17 \log W$	$17 \times 1.1249=19.13''$
f_2 (S)	3.00 sq. m. .50 0.7781	10.4771-10 9.6990-10 0.7781	$m_2 = \frac{m_1 m_3}{m_1 + m_3}$ $= \frac{40 \times 40}{40 + 40} = 20''$	$z=m_2 f_2 (S)$ $z=20 \log S$	$20 \times 0.7781=15.56''$

* In the construction of all the charts, the values of m given in the text are those which were employed originally in the construction of the scales; these figures do not refer to the charts as here reproduced since in all cases they are reductions of the original drawings.

as 24 inches we may select for trial 40 inches for m_1 ; then the equation of the H scale, $x = m_1 f_1 (H)$ becomes $x = 40 \times 0.725 \log H$, or $x = 29 \log H$; if the range of $\log H$ is 0.4673 (the difference between \log upper limit and \log lower limit) the length of the scale will be $40 \times 0.725 \times 0.4673$, or 13.55 inches; the length of the scale so worked out is satisfactory for our purposes; otherwise a different modulus must be tried. Likewise, a suitable modulus must be chosen for the W scale. If 40 inches is again selected, and since the equation of the W scale is $y = m_1 f_1 (W)$, then by substitution $y = 40 \times 0.425 \log W$ and its length is $40 \times 0.425 \times 1.1249 = 19.13$ inches. Since moduli m_1 and m_2 have been chosen, modulus m_3 is fixed by the formula $m_3 = (m_1 m_2) / (m_1 + m_2) = (40 \times 40) / (40 + 40) = 20$ inches. The distance between H and W scales is arbitrarily selected as 10 inches and the S scale is erected exactly half way between them because $m_1 = m_2$.

Having completed these preliminary calculations, the next step is to lay out these scales. First, find the middle point of the H scale by taking half the sum of the log limits: $(2.3424 + 1.8751) / 2 = 2.1088$, the antilog of which is 128.5 cm. Locate this point on the scale by a prick mark; determine where the point representing 125 cm. will be on the scale: this will be at a distance of $40 \times 0.725 (\log 128.5 - \log 125)$ inches below the central point 128.5, or $29 \times (2.1088 - 2.0969) = 0.35$ inches; locate and draw in the point representing 125 cm. on the H scale. Calculate the position of every 5 cm. variation in height above and below 125 until the limits 220 and 75 are reached. This can be done most efficiently by writing in a row all the logs of every 5 cm. above and below 125 and subtracting from each the log of 125 as follows:

120	125	140
2.1130	2.1308	2.1461
2.0909	2.0969	2.0869
0.0170	0.0334	0.0492

The resulting numbers, since the equation of the H scale is $x = 29 \log H$, are then multiplied on the slide rule by 29. For example: the point 130 will be at $29 \times 0.017 = 0.493$ inches above the point 125. The scale is then completed by dividing the intervening distances into equal parts. This is not strictly accurate, but it is sufficiently so when the distances between every fifth point are small, otherwise they should be calculated. This completes the H scale.

In like manner construct the W scale, except that the differences of the logs must be multiplied by 17 instead of 29, since the equation of the W scale is $y = 17 \log W$.

To determine a starting point for the graduations on the S scale, draw a straight line connecting two points on the H and W scales: for example, at 120 on H and at 50 on W. Solve mathematically this equation $S = 120^{0.725} \times 50^{0.425} \times 0.007184$, which is 1.219. Then the point where the line joining 120 on the H scale and 50 on the W scale crosses the S scale must be the point 1.219 sq. m. on the S, or the surface area scale. The point 1.200 on the S scale will be at a distance below 1.219 by $20 \times (\log 1.219 - \log 1.200) = 20 \times (0.0860 - 0.0792) = 0.136$ inches. Proceed as in the H scale and calculate the position of every 0.05 sq. m. surface area variation, multiplying the difference of logs by 20 since the equation of the S scale is $z = 20 \log S$. Draw in the scales, thus completing the chart.

The chart for the determination of the basal metabolic rate according to the formula $BMR = (C \cdot N) / N$ is constructed in exactly the same manner as that for the surface area just described, since $(BMR + 1) \times N = C$ is in the form of the general equation $(u) \times (v) = w$, or $\log u + \log v = \log w$.

The chart for total basal calories per day, however, is somewhat more complicated in that it is a combination of the two preceding charts and contains five variables and solves the two formulae: (1) $H^{0.725} \times W^{0.425} \times 0.007184 = S$,

and (2) $S \times C \times 24 = TC$, or it may be expressed as one equation of the general form $f_1(u) + f_2(v) + f_3(w) + \dots = f_4(t)$ or $f_1(u), f_2(v), f_3(w), \dots = f_4(t)$ for four or more parallel scales. Since the chart is already drawn for the surface area as determined from the height and weight, we can use these same scales for the first half of the new chart for the determination of the total basal calories for twenty-four hours, providing we make use of the same modulus for the surface area (S) scale in the calculation of the additional scales. Proceeding as before, make Table II as follows:

TABLE II.

Scale	Leaves	Log Leaves	Modulus	Scales Equation	Leaves of Scale
S	3.00 0.50	10.4771-10 9.6990-10	$m_s = 20$	$x = m_s f_1(S)$	$20 \times 0.7781 = 15.56$
C	100 25	0.7781 2.0000 1.3979	$m_c = 30$	$z = 20 \times \log S$ $w = m_c f_1(C)$	$30 \times 0.6921 = 18.00$
TC	7000 500	0.6921 3.8451 2.6990 1.1461	$m_{tc} = \frac{m_s m_c}{m_s + m_c} = \frac{20 \times 30}{20 + 30} = 12$	$v = 30 \times \log C$ $v = 12 \times \log TC$	$12 \times 1.1461 = 13.70$

The modulus ($m_s = 20$) for S is fixed, because the surface area scale as obtained from height (H) and weight (W) is already drawn. By trial, a modulus (m_c) of 30 for the C scale is satisfactory, as it gives by the formula $m_s = (m_s m_c) / (m_s + m_c) = (20 \times 30) / (20 + 30) = 12$ as the modulus (m_{tc}) of the TC scale. These moduli are satisfactory because they give suitable scale lengths and at the same time allow a proper placing of the new scales in relation to the original scales. The TC scale is erected so that the ratio of the distance from the S

scale to the TC scale is to the distance from the TC scale to the C scale as 20 is to 30; since the distance between the S scale and the C scale may be satisfactorily placed at 8 inches, the distance of the TC scale from the S scale must be 3.2 inches. Proceed as described previously and find the center of the C scale and determine every fifth calorie. For convenience the Du Bois normal standards for men and women are also indicated along this scale. To work this chart, two index lines are necessary; the first joins the known height and weight, giving the surface area where it intersects the S line, and the second connects this latter point to the normal standard or C scale, giving, where it crosses the TC scale, the number of total basal calories per day for a normal person of known surface area.

Another type of chart known as the Z chart, is often very valuable for solving the general equations of the form $f_1(u) = f_2(v) \times f_3(w)$ or $f_1(u) = f_2(v) : f_3(w)$. The latter equation may be brought into the form of the first by taking the logs of both members of the equation as follows: $\log f_1(u) = \log f_2(v) + \log f_3(w)$. The first form of these equations is the same as the second form of the equation used in the construction of the preceding charts in which, however, three parallel logarithmic scales were used, while in the Z chart the scales are natural; two of the scales are parallel and uniform, while the third scale is not uniform and is laid out on a diagonal which connects the zero points of the other two scales, hence the name "Z chart." It can be used to solve the equations contraction in volume equals original volumes times per cent. of oxygen or carbon dioxide, or $D = E \times \%$, and the ratio between the carbon dioxide eliminated and the oxygen absorbed or $CO_2/O_2 = R.Q.$ The Z type of chart is of especial advantage in the first of these equations because the original volume and contraction in volume scales are uniform and may be constructed similar to those on the Haldane buret from which the readings are obtained. The parallel line type of chart, like those for Charts 1 and 2, could be used, but it would be less accurate and less easy to read in this instance, because the divisions would be constructed on a log scale and towards 10 would be small and difficult to interpolate.

In constructing the Z chart, select a convenient size of paper (20 inches by 30 inches) and lay out the two natural parallel scales any desired distance apart with the diagonal connecting the zero points of their scales. The natural scales then will run in opposite directions. According to the equation, $D = E \times \%$ make Table 3.

Lay off the D scale according to the scale equation $x = m_1(D)$, and the E scale according to the equation $y = m_2(E)$. By trial, we find that a modulus of 10 inches is suitable for both the contraction (D)

scale and original volume (E) scale. These scales may be laid off easily by means of an engineer's rule divided into tenths.

TABLE III.				
Scale	Length	Monitors	Scale Equation	Length of Scale
D	0 to 2.5	$m = 10^*$	$x = m \cdot f_1(D)$ $x = 10 \times D$	$10 \times 2.5 = 25^*$
E	7.5 to 10	$m = 10^*$	$y = m \cdot f_1(E)$ $y = 10 \times E$	$10 \times 2.5 = 25^*$
%	0 to 80	.....	$z = k \cdot \frac{m \cdot f_1(\%) }{m \cdot f_1(\%) + m_0}$ $z = 101.3 \cdot \frac{10 \times \% }{(10 \times \%) + 10}$	$101.3 \cdot \frac{10 \times 0.80}{(10 \times 0.80) + 10} = 23.4^*$

Since the diagonal k connects the zero points of the two parallel scales, and since a suitable distance between the two parallel scales is 16 inches, and since for convenience in reading we have placed the point 10 on the original volume scale (E) exactly opposite the zero point on the contraction in volume scale (D), we have a right triangle and can easily calculate the diagonal k because it is the hypotenuse of a right triangle. For example, the complete length of the original volume scale 0 to 10 is 100 inches. Then the diagonal

$$k = \sqrt{100^2 + 16^2} = 101.3 \text{ inches}$$

The per cent. scale may be laid out on the diagonal according to the formula

$$z = k \cdot \frac{m \cdot \%}{(m \cdot \%) + m_0} \quad \text{or} \quad z = 101.3 \cdot \frac{10 \times \%}{(10 \times \%) + 10}$$

where z equals the distance from 0 to the positions on the diagonal representing the various values of the percentage scale.

Since the original volume is always between 7.5 and 10 that part of the chart from 0 to 7.5

is unnecessary and is therefore omitted. If this scale and the diagonal were prolonged, however, the latter would intersect the original volume scale at its zero point. Since only a segment of the chart is being constructed the diagonal must be laid off so that the tangent of the angle it makes with the contraction in volume scale is $16/100 = 4/25$. Therefore, to lay off this line measure 25 inches along the contraction in volume scale, starting from the zero point of that scale; measure four inches out perpendicular to the 25-inch point, and draw a line from the zero point of the contraction in volume scale through the end of the four-inch line; this will give a line laid off whose tangent to the contraction in volume scale is $16/100$. Since the per cent. scale is not uniform, it is necessary to calculate the location of every 0.5 per cent. by the scale formula; the 0.1 per cent. divisions may then be determined with sufficient accuracy by dividers. Complete the chart by drawing in the scales. The chart for the determination of the respiratory quotient is made in exactly the same manner as the preceding.

To work the chart a ruler is placed on the points representing the original volume and the contraction in volume, and the percentage is read off at the point where the ruler crosses the diagonal or per cent. scale.

In the preceding charts the equations have contained only three or five variables, and the charts are made so that the equation can be solved by means of one or two index lines. In the chart for the calories per square meter per hour, however, there are eight variables and one constant to deal with since:

$$C = \frac{Fg \times Cvo, x \text{ Fstpd } x \%O_2, x G \times 60}{M \times S}$$

and any chart which solves this equation must necessarily be more complex. In this equation C represents the basal calories per square meter per hour found experimentally; Fg , the factor for conversion of the linear rise in centimeters of the gasometer into volume in liters; Cvo_2 , the calorific value of oxygen for various respiratory quotients (R.Q.); Fstpd , the factor for reducing the observed gas volumes to standard temperature and pressure, dry; $\%O_2$, the per cent. of oxygen absorbed from the inspired air; G , the rise of the gasometer in centimeters; M , the duration of the test in minutes; S , the surface area in square meters and 60 converts the time from minutes to hours.

A combination of three superimposed rectangular charts was developed to solve this equation containing eight factors. A single rectangular chart consists of four natural scales arranged on each side and may be used to represent an equation of the form:

$$\frac{f_1(u)}{f_1(v)} = \frac{f_2(w)}{f_2(q)}$$

Three of the moduli may be chosen arbitrarily, but the fourth is fixed and solved from the equation,

$$\frac{m_1}{m_2} = \frac{m_3}{m_4} \text{ or } m_4 = \frac{m_2 m_3}{m_1}$$

A diagonal must connect the zero points of the four scales as in the x form of chart. The u and v scales must be laid off on opposite sides of the rectangle and the w and q scales on the other two sides with the 0 points of the u and w scales starting from the same point; similarly, the 0 points of the v and q scales must coincide at the opposite end of the diagonal. This diagonal, therefore, connects all four scales at their zero points. In the simple rectangular type of chart only four variables can be dealt with at one time; consequently the procedure was first to take three variables, G , C , and $(60 \times \%O_2)$ and group all the other variables into one variable, X , and construct a chart; then take X with two of the other quantities $1/Fstpd$ and S and the remaining variables grouped as Y , and construct a second chart superimposed on the first; finally take Y with the remaining factors Fg , M and Cvo , and construct a third chart superimposed on the two preceding charts. The composite chart is solved by the use of six index lines; to facilitate its use a key indicating the order in which these index lines are to be made, is drawn in a convenient place on the chart. For the purpose of construction the original equation

$$C = \frac{Fg \times Cvo \times Fstpd \times (60 \times \%O_2) \times G}{M \times S}$$

is expressed according to the form of the general equation in the three following equations:

- (1) $\frac{X}{(60 \times \%O_2) \times G} = \frac{C}{S}$
- (2) $\frac{X}{1} = \frac{S}{Fstpd}$
- (3) $\frac{M \times Cvo}{Fg \times Y} = \frac{M \times S}{Fstpd \times Cvo \times Fg}$; where X represents $S \times C$
and Y represents $Fstpd \times G \times 60 \times \%O_2$

By the proper choice of moduli it was found possible to obtain suitable scales for the various factors, and at the same time to prevent overlapping of the scales where more than two occurred on the same side of the chart. In order to distribute all the factors according to the form of the general equation,

$$\frac{f_1(u)}{f_2(v)} = \frac{f_3(w)}{f_4(q)}$$

it was found necessary to transfer by inversion, one of the factors $Fstpd$ naturally occurring in the numerator to the denominator.

A size of paper four feet square was chosen for drafting. First, the quantities G , C and $(60 \times \%O_2)$ are taken and all other quantities are grouped together under the variable X . It was found that the constant 60 could be taken care of best by using it with the per cent. of oxygen absorbed. If the modulus of X is taken for trial as 4.8, of $(60 \times \%O_2)$ as 6, and of G as 0.4, the modulus of C must be $m_c = 6 \times 0.4/4.8 = 0.5$, which is found suitable. The C scale will stretch from 0 to 37.5 inches; but the part of the scale from 0 to 15 need not be drawn. Similarly, in the other scales, only the part used need be actually marked off. The G , C and $(60 \times \%O_2)$ scales with a diagonal connecting the zero point of the G scale with that of C and $(60 \times \%O_2)$ scale can now be constructed. A second chart must be constructed superimposed on the first one, using the quantities $Fstpd$ and S and grouping the remaining quantities under the variable X . Y must be used in this chart also so as to make this process continuous. In the second equation,

$$\frac{X}{1} = \frac{S}{Fstpd}$$

the modulus for X (4.8) is already fixed from the preceding chart; by trial, the modulus of 10 inches for S and of 14.4 inches for $1/Fstpd$ is satisfactory. This latter scale, because of the form of the original equation, is an inverse instead of a uniform scale and therefore its divisions are not equal, and in consequence the position of its main points must be determined by calculation from the scale formula. The modulus for Y must therefore be $m_y = 10 \times 14.4/4.8 = 30$. However, like X , the Y scale need not be graduated because it is a group of factors. From the form of this second equation the $Fstpd$ (or rather $1/Fstpd$) scale must be constructed opposite the Y scale and on the same line as the $(60 \times \%O_2)$ scale and the X scale must be opposite the S scale, and the S scale adjacent to the Y scale and on the same line as the G scale.

The third and final equation is $M/Fg = Cvo/Y$. The modulus of Y is fixed from the previous equation and equal to 30. By trial the modulus m_{fg} for Fg = 7.2, are found suitable. Then the modulus m_m for M is found by the equation,

$$m_m = \frac{50}{30} \times 7.2 = 12$$

which is suitable, as it makes the minute scale a convenient length (30 inches). Complete the

TABLE IV.

	SCALE	LIMITS	MODULUS	SCALE EQUATION	LENGTH OF SCALE
(1)	$\frac{X}{60 \times \%O_2} = \frac{G}{C}$				
	X	.....	$m_1 = 4.8''$	.....	.....
	$60 \times \%O_2$	0 to 0.06	$m_2 = 6.0''$	$x_1 = m_2 f_1 (\%O_2)$	$6 \times 60 \times 0.06 = 21.6''$
	G	0 to 90	$m_3 = 0.4''$	$y_1 = m_3 f_2 (G)$	$0.4 \times 90 = 36''$
	C	0 to 75	$m_4 = \frac{m_2 m_3}{m_1}$	$z = m_4 f_3 (C)$	$0.5 \times 75 = 37.5''$
			$\frac{6.0 \times 0.4}{4.8} = 0.5''$	$z = 0.5 \times C$	
(2)	$\frac{X}{1} = \frac{S}{Y}$				
	Fstpd	.....	$m_1 = 4.8''$	.....	.....
	X	$\frac{1}{0.75}$ to $\frac{1}{1}$ or	$m_2 = 14.4''$	$y_1 = m_2 f_1 \left\{ \frac{1}{\text{Fstpd}} \right\}$	$14.4 \times 1.33 = 19.2''$
	1	1.33 to 1		$y_2 = 14.4 \times \frac{1}{\text{Fstpd}}$	$\frac{14.4''}{\text{Length}} = 4.8''$
	Fstpd	0 to 2.6	$m_3 = 10''$	$x_2 = m_3 f_2 (S)$	$10 \times 2.6 = 26''$
	S	.....	$m_4 = \frac{14.4 \times 10}{4.8} = 30''$	$x_3 = 10 \times S$	
	Y			.....	.....
(3)	$\frac{M}{Fg} = \frac{Cvo_2}{Y}$				
	M	0 to 15	$m_1 = \frac{50}{6} \times 7.2 = 2$	$x_1 = m_1 f_1 (M)$	$2 \times 15 = 30''$
	Fg	0 to 2.2	$m_2 = 7.2''$	$y_1 = m_2 f_2 (Fg)$	$7.2 \times 2.2 = 15.8''$
	Cvo ₂	0 to 5	$m_3 = \frac{50}{6}$	$x_2 = m_3 f_3 (Cvo_2)$	$\frac{50}{6} \times 5 = 41.6''$
	Y	.....	$m_4 = 30''$	$x_3 = \frac{50}{6} \times Cvo_2$	.....

* Note that the zero point of an inverted scale is infinity; therefore its divisions are not uniform and every point must be calculated.

chart by drawing in the various⁸ scales. To avoid looking up in a table the calorific value of oxygen for various respiratory quotients, these values were charted in the corresponding terms of the respiratory quotient.

To read the chart one should follow the key, first arranging the data in the following order: minutes (m), factor of gasometer (Fg), respiratory quotient (Cvo₂), surface area (S), factor for reducing to standard temperature and pressure dry (Fstpd), oxygen per cent. (%O₂), and gasometer rise (G). Connect minutes with gasometer factor and locate the intersection on the diagonal with a sharp pencil or pin; next

connect this point with the respiratory quotient and find intersection on X axis; from this point draw a straight line to the surface area and again locate the intersection on the diagonal; connect this point with the surface area and find its intersection on the Y axis; then connect this point and oxygen per cent., and again note the intersection on the diagonal; connect this point and the gasometer reading, and where this line intersects the C axis read the answer in calories per square meter per hour.

The various scales are such that their limits cover the range of all except a few extreme

cases. With the exception of the scale for reducing the gas volume to standard temperature and pressure dry (Fstpd), the scales are constructed on the basis of uniform instead of logarithmic divisions so that interpolation can be readily and accurately be made by dividers. The scale for reducing to standard temperature and pressure dry (Fstpd) is inverted and therefore not uniform, and so cannot be prolonged in an arithmetical ratio.

METHOD OF USING NOMOGRAPHIC CHARTS.

To use the charts accurately the following general precautions are necessary: The charts must be laid on a perfectly flat, smooth table, and must not be exposed to moisture. The ruler or straight edge to indicate the index line must be thin and true, and contain no irregularities. To prevent injury to the charts, it is best not to draw the various index lines but merely to indicate their positions by the straight edge of the ruler. By carrying out the following steps the position of the index line can be found most quickly: Locate the point on the right hand scale by means of a needle mounted in a handle; the latter can be improvised by sticking a needle through the rubber eraser of a lead pencil; bring the ruler's edge against the needle, which must be held perpendicular; with the little finger of the right hand, hold the ruler against the needle, which will serve as a pivot around which the ruler may rotate; swing the other end of the ruler over the left-hand scale position, being sure that the eye is perpendicular to this position, otherwise a considerable error will occur; hold the ruler firm with the left hand and place the needle exactly on the intersection of the ruler with the middle scale; if this is the answer, remove the ruler to facilitate reading of the scale; if further index lines are necessary, swing the left end of the ruler around the new needle position as pivot and establish the second index line by bringing the left end of the ruler directly over the new left scale position; the details of the maneuvers for each chart are given below.

Chart 1. Determination of the Carbon Dioxide and Oxygen Percentages.

In analyzing the expired air in the Haldane gas analysis apparatus, the various volumetric readings are made and the proper buret corrections added to them. The contraction in volume for carbon dioxide and oxygen is found by subtraction. To determine by the chart the carbon dioxide and oxygen percentages, place the needle upright on the right-hand scale over the original volume (9.426); bring the ruler close up against the needle and swing the edge of the other end of the ruler up to the contraction in volume for carbon dioxide (0.326) and read the answer (3.46%) on the per cent. scale; in like manner determine the oxygen per cent.

Chart 2. Determination of the Respiratory Quotient.

The respiratory quotient is the ratio between the carbon dioxide produced and the oxygen absorbed. The carbon dioxide produced is the difference between the per cent. of carbon dioxide in the expired (3.47%) and the per cent. in the inspired air (0.04%). The oxygen absorbed is the difference between the per cent. of oxygen in the expired air (16.62%) and the corrected inspired oxygen percentage (21.16%) obtained from Table 1 and corresponding to the sum of the carbon dioxide and oxygen per cent. of the expired air. To determine by the chart the respiratory quotient, place the needle on the right-hand scale position representing the per cent. of oxygen (4.54%) absorbed; bring the ruler against the needle and swing the left end to the exact position representing the per cent. of carbon dioxide (3.43%) produced; read the respiratory quotient, 0.76, on the middle scale.

Chart 3. Determination of the Surface Area (Du Bois).

In order to determine the surface area, place the needle on the scale representing the weight of the subject (53.1 kg); bring the ruler against the needle and swing its other end exactly over the height of the subject (155 cm.) and read the answer (1.50 sq. m.) on the middle scale.

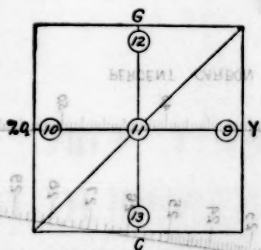
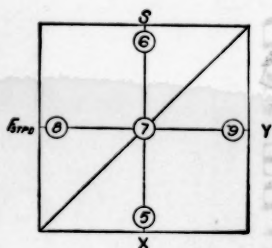
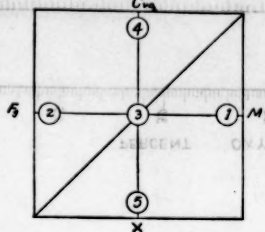
Chart 4. Determination of the Calories Per Square Meter Per Hour.

The principle of Chart 4 is exactly the same as in the preceding charts except that as the chart solves an equation of eight factors and one constant, six index lines are necessary. An example for working the chart with the factors arranged in the order in which they are used, is as follows: Duration of experimental period in minutes: $M = 9.00$; gasometer factor for converting the linear rise of the gasometer to volume of expired air: $Fg = 1.26$; the calorific value of oxygen for the experimental respiratory quotient scaled on the chart as respiratory quotient: $Cvo = 0.76$; the surface area of the subject: $S = 1.50$; the factor for reducing the gas volume read at experimental temperature of 22.8°C . and barometer of 728 mm. to standard temperature and pressure dry: $Fstpd = 0.854$; per cent. of oxygen absorbed: $\%O_2 = 4.54$; rise of the gasometer: $G = 56.7$. To solve the example, proceed according to the key on the chart: (1) Place the needle on $M = 9.00$; (2) swing the ruler exactly over $Fg = 1.26$; (3) place the needle on the diagonal exactly where the edge of the ruler crosses; (4) swing the ruler around the needle as a pivot to respiratory quotient (Cvo) $= 0.76$; (5) place the needle on the bottom line X exactly where the ruler crosses it; (6) swing the ruler around the needle as a pivot to $S = 1.50$;

RESPIRATORY QUOTIENT (C_{res})

GASOMETER (6)

Key.



FACTOR TEMP & PRESS DRY (Temp)

GASOMETER FACTOR (Fg)

OXYGEN % ABSORBED (%Q)

CALORIES PER 36

COMI

MINUTE (M)
CHARTS 1 AND 2

100 99 98 97 96 95 94 93 92 91 90 89 88

VOLUME.

CHART FOR BASAL METABOLIC RATE DETERMINATIONS

CO₂ AND O₂
PERCENTAGES

WM. BOOTHBY, R.B. SANDIFORD.

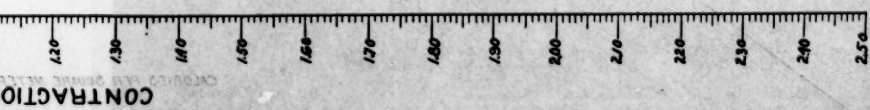
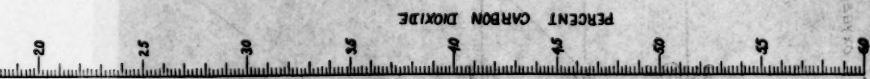
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

ACTION IN VOLUME.

15 20

55 60

PERCENTAGES
WM. BOOTHBY, R.B. SANDIFORD,
JANUARY 1921.



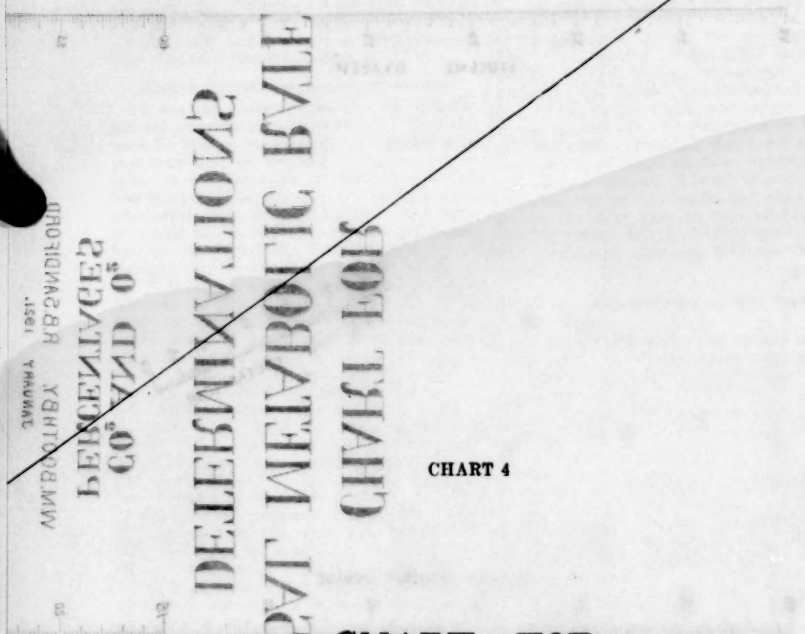


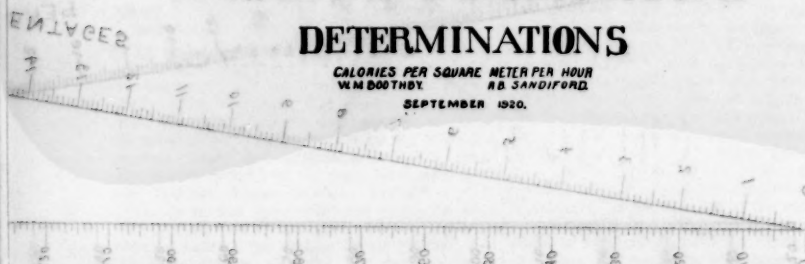
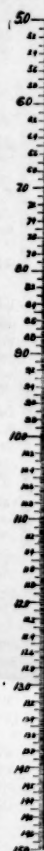
CHART 4

CHART FOR BASAL METABOLIC RATE DETERMINATIONS

CALORIES PER SQUARE METER PER HOUR
W.M. BOOTHBY R.B. SANDIFORD

SEPTEMBER 1920.

CHART 1 AND 3
MINUTES (M)



PERCENTAGE PER HOUR (C)
FRACTION IN LOGS

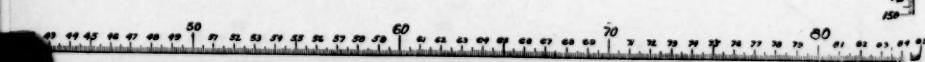


CHART FOR BASAL METABOLIC RATE DETERMINATIONS

WM. BOOTHBY, RBSANDIFORD.
SEPTEMBER 1920

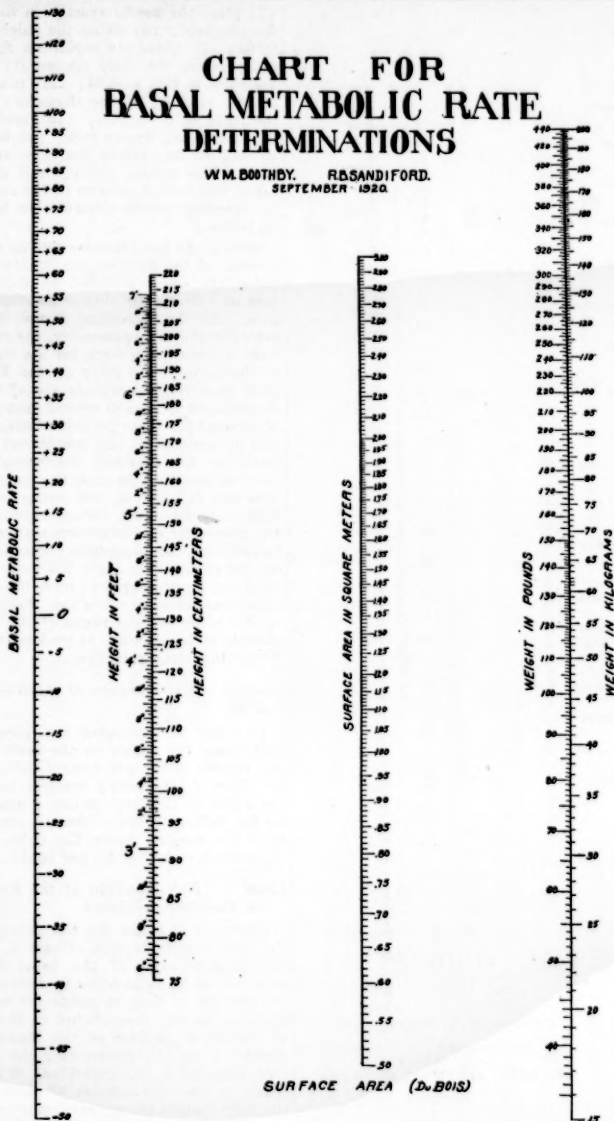
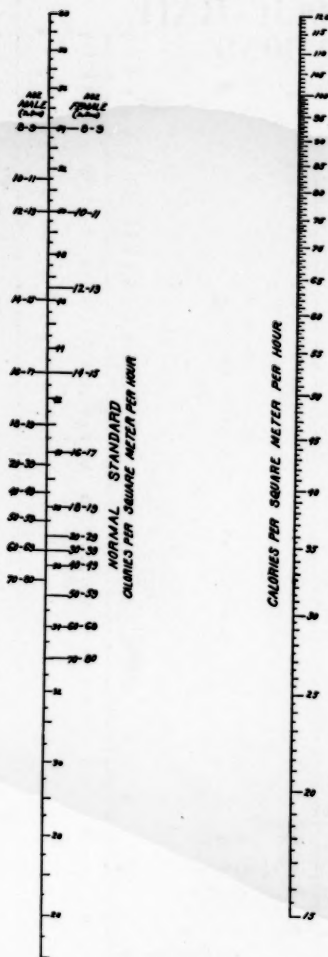


CHART 3



BASAL METABOLIC RATE.

CHART 5

(7) place the needle exactly on the crossing of the diagonal; (8) swing the ruler to $F_{std} = 0.854$; (9) place the needle on the line Y exactly where the ruler crosses it; (10) swing the ruler to $\%O_2 = 4.54$; (11) place the needle on the crossing of the diagonal; (12) swing the ruler to $G = 56.7$; (13) read the answer in calories per square meter per hour, 58.4, on the bottom line where the ruler crosses the C. scale. This answer will agree if care has been taken within ± 0.2 calories of the result obtained by carrying out the calculation by four-place logarithms.

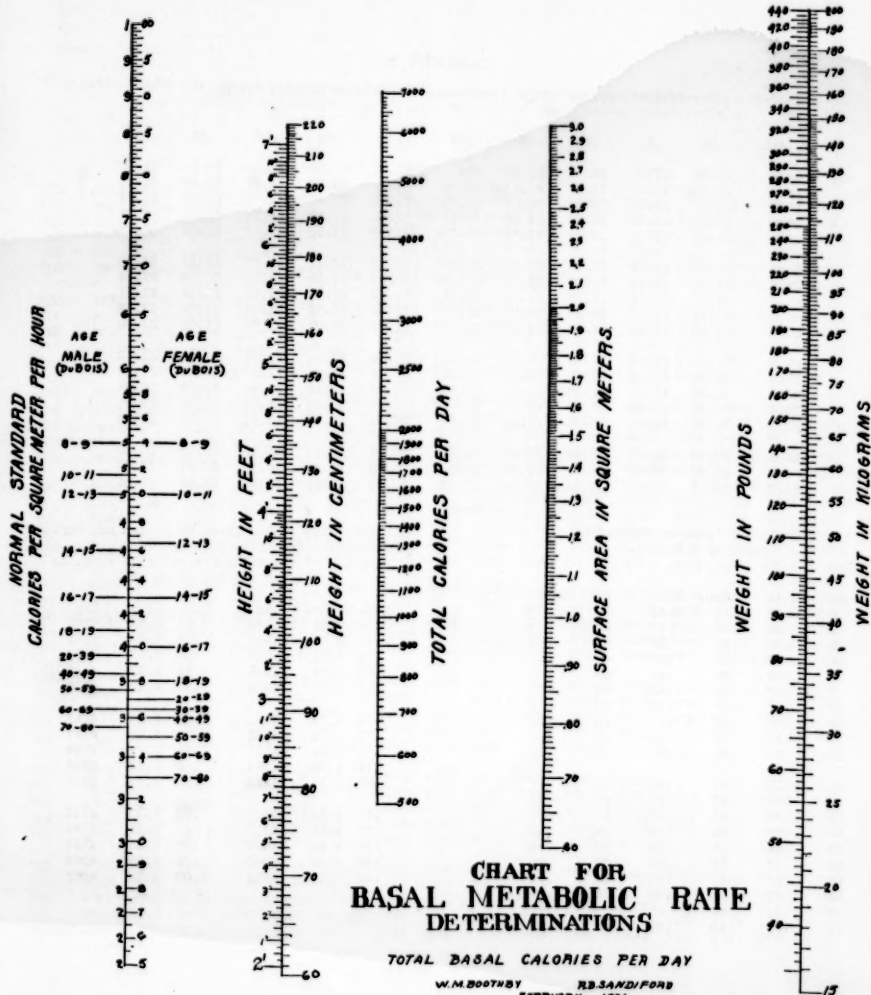
Should the total calories per hour be desired, instead of the calories per square meter per hour, procedure six is modified by using a surface area of 1.00 instead of the individual's surface area. As the gasometer factor is always the same for the same gasometer, the calculator can make a permanent mark for his own gasometer at the appropriate place on the F_g scale. As most experimental periods are of ten minutes' duration, the first and second maneuvers can be eliminated for those periods of exactly ten minutes by making a fine permanent intersection mark on the diagonal corresponding to the third maneuver. In case the gasometer factor does not fall within the range of the scale drawn on the chart, the appropriate point for any gasometer can be determined readily by interpolation, and its position permanently marked on the chart. Similarly the oxygen per cent. scale can be prolonged to meet the needs of the occasional instances in which the per cent. absorbed is beyond the range of the scale; occasionally it is necessary to prolong the base line X for the sixth maneuver.

Chart 5. Determination of the Basal Metabolic Rate.

In order to determine the basal metabolic rate, place the needle on the scale for calories per square meter per hour (58.4) determined by Chart 4, and bring the left hand edge of the ruler to the appropriate normal standard on the left-hand scale (female, aged 30), and read the answer where the ruler crosses the right-hand scale (+ 60 per cent.).

Chart 6. Determination of the Basal Calories for Twenty-four Hours.

Charts 1 to 5 are for the determination of the basal metabolic rate. Chart 6, however, is for the calculation of the basal calories for twenty-four hours in order to determine readily the amount of food requisite for various individuals. It was constructed at the suggestion of Dr. R. M. Wilder of the Mayo Clinic for dietetic work. In determining the quantity of food required by an individual, it is more accurate to base the number of food calories on the four factors of age, sex, height and weight, according to Du Bois' standards, than on weight alone, as has been the general custom.



TABLES 1, 2, 3.

Correction Inspired Oxygen Percentage to Basis of Expired Volume.

CO ₂ + O ₂	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
19.5	21.32	21.32	21.31	21.31	21.31	21.31	21.30	21.30	21.30	21.30
19.6	21.29	21.29	21.29	21.28	21.28	21.28	21.28	21.27	21.27	21.27
19.7	21.27	21.26	21.26	21.26	21.26	21.26	21.25	21.25	21.25	21.24
19.8	21.24	21.24	21.24	21.23	21.23	21.23	21.22	21.22	21.22	21.22
19.9	21.21	21.21	21.21	21.21	21.20	21.20	21.20	21.20	21.19	21.19
20.0	21.19	21.18	21.18	21.18	21.18	21.17	21.17	21.17	21.17	21.16
20.1	21.16	21.15	21.15	21.15	21.15	21.15	21.15	21.14	21.14	21.14
20.2	21.13	21.13	21.13	21.13	21.12	21.12	21.12	21.12	21.11	21.11
20.3	21.11	21.10	21.10	21.10	21.10	21.09	21.09	21.09	21.09	21.08
20.4	21.08	21.08	21.08	21.07	21.07	21.07	21.07	21.06	21.06	21.06
20.5	21.05	21.05	21.05	21.05	21.04	21.04	21.04	21.04	21.03	21.03
20.6	21.03	21.03	21.02	21.02	21.02	21.02	21.01	21.01	21.01	21.00
20.7	21.00	21.00	21.00	20.99	20.99	20.99	20.99	20.98	20.98	20.98
20.8	20.98	20.97	20.97	20.97	20.96	20.96	20.96	20.96	20.95	20.95
20.9	20.95	20.95	20.94	20.94	20.94	20.94	20.93	20.93	20.93	20.93
21.0	20.92	20.92	20.92	20.91	20.91	20.91	20.91	20.90	20.90	20.90
21.1	20.90	20.89	20.89	20.89	20.89	20.88	20.88	20.88	20.87	20.87
21.2	20.87	20.87	20.86	20.86	20.86	20.86	20.85	20.85	20.85	20.85

Equivalent of Seconds in Decimal Parts of a Minute.

Sec.	Min.	Sec.	Min.	Sec.	Min.
1	0.02	21	0.35	41	0.68
2	.06	22	.37	42	.70
3	.06	23	.38	43	.72
4	.07	24	.40	44	.75
5	.08	25	.42	45	.75
6	.10	26	.43	46	.77
7	.12	27	.45	47	.78
8	.13	28	.47	48	.80
9	.15	29	.48	49	.82
10	.17	30	.50	50	.83
11	.18	31	.52	51	.85
12	.20	32	.53	52	.87
13	.22	33	.55	53	.88
14	.23	34	.57	54	.90
15	.25	35	.58	55	.92
16	.27	36	.60	56	.93
17	.28	37	.62	57	.95
18	.30	38	.63	58	.97
19	.32	39	.65	59	.98
20	.33	40	.67	60	1.00

Calorific Value of One Liter of Oxygen for Various (Non-Protein) Respiratory Quotients together with the Log of the Calorific Value to which is Added the Log of 80 min.

R.Q.	Cals.	Log	R.Q.	Cals.	Log
0.71	4.69	2.4494	0.86	4.88	2.4662
.72	4.70	4505	.87	4.89	4673
.73	4.71	4517	.88	4.90	4684
.74	4.73	4528	.89	4.91	4695
.75	4.74	4539	.90	4.92	4706
.76	4.75	4551	.91	4.94	4716
.77	4.76	4562	.92	4.95	4727
.78	4.78	4573	.93	4.96	4738
.79	4.79	4584	.94	4.97	4748
.80	4.80	4598	.95	4.99	4759
.81	4.81	4607	.96	5.00	4770
.82	4.83	4618	.97	5.01	4781
.83	4.84	4629	.98	5.02	4791
.84	4.85	4640	.99	5.03	4802
.85	4.86	4651	1.00	5.05	4813

TABLE 4.

Log Factor for Reducing Volume of Gases to Standard Temperature and Pressure, Dry; Including Reduction of Barometric Height to Standard Temperature (brass scale).

Barometer in Millimeters.

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
700	1.9298	9277	9255	9233	9211	9188	9164	9141	9117	9093	9068	9044	9017	8991	8964	8937
702	9310	9289	9267	9245	9223	9200	9177	9153	9129	9105	9080	9056	9029	9003	8976	8949
704	9323	9302	9279	9257	9235	9212	9189	9166	9142	9118	9095	9069	9042	9016	8989	8962
706	9335	9314	9292	9270	9248	9225	9202	9179	9155	9131	9106	9082	9055	9029	9002	8975
708	9348	9327	9305	9283	9260	9237	9214	9192	9167	9143	9118	9094	9067	9041	9014	8987
710	9361	9340	9318	9296	9273	9251	9228	9205	9181	9157	9132	9108	9081	9055	9027	9001
712	9373	9352	9330	9308	9285	9263	9240	9217	9193	9169	9144	9120	9093	9067	9040	9015
714	9385	9364	9342	9320	9298	9275	9252	9229	9206	9181	9157	9133	9106	9080	9054	9027
716	9398	9377	9355	9333	9311	9288	9265	9242	9218	9194	9170	9146	9119	9093	9067	9040
718	9410	9389	9367	9345	9323	9300	9277	9254	9230	9206	9182	9158	9131	9105	9080	9052
720	9423	9402	9380	9358	9336	9313	9290	9267	9244	9220	9196	9171	9145	9119	9093	9066
722	9435	9414	9392	9370	9348	9325	9302	9279	9256	9232	9207	9183	9157	9131	9105	9078
724	9447	9426	9404	9382	9360	9337	9314	9291	9268	9244	9219	9195	9170	9144	9117	9090
726	9459	9439	9416	9394	9373	9350	9327	9304	9280	9256	9232	9208	9183	9157	9130	9103
728	9472	9451	9428	9406	9385	9362	9339	9316	9292	9268	9244	9220	9195	9169	9142	9115
730	9484	9463	9441	9419	9398	9375	9352	9329	9306	9281	9257	9233	9208	9182	9155	9128
732	9496	9475	9453	9431	9410	9387	9364	9341	9317	9293	9269	9245	9220	9194	9167	9140
734	9508	9487	9465	9443	9422	9399	9376	9353	9329	9305	9281	9257	9232	9206	9180	9153
736	9520	9499	9478	9456	9434	9411	9388	9365	9342	9318	9294	9270	9244	9218	9192	9166
738	9532	9511	9490	9468	9446	9423	9400	9377	9354	9330	9306	9282	9256	9230	9204	9178
740	9544	9523	9502	9480	9459	9436	9413	9390	9367	9343	9318	9294	9268	9243	9216	9190
742	9556	9535	9514	9492	9471	9448	9425	9402	9379	9354	9330	9306	9280	9255	9228	9202
744	9569	9547	9526	9504	9483	9460	9437	9414	9391	9366	9342	9318	9292	9267	9241	9214
746	9580	9559	9537	9516	9494	9472	9449	9426	9403	9379	9355	9331	9305	9280	9254	9227
748	9592	9571	9549	9528	9506	9483	9461	9438	9415	9391	9367	9343	9317	9292	9266	9239
750	9603	9583	9561	9540	9518	9495	9473	9450	9427	9403	9379	9355	9330	9304	9278	9251
752	9615	9594	9573	9551	9530	9507	9485	9462	9439	9415	9391	9367	9342	9316	9290	9263
754	9627	9606	9585	9563	9541	9519	9497	9474	9451	9427	9403	9379	9354	9328	9303	9275
756	9639	9618	9596	9575	9553	9531	9509	9486	9462	9439	9415	9391	9366	9340	9315	9288
758	9651	9630	9608	9587	9565	9542	9521	9498	9474	9450	9427	9403	9377	9352	9327	9300
760	9662	9641	9620	9598	9577	9554	9532	9509	9486	9462	9439	9415	9389	9364	9339	9312
762	9674	9653	9632	9610	9588	9566	9544	9521	9498	9474	9451	9427	9401	9376	9351	9324
764	9685	9665	9643	9621	9600	9578	9556	9532	9509	9486	9463	9438	9413	9388	9363	9336
766	9697	9676	9655	9633	9612	9589	9566	9544	9521	9498	9474	9450	9425	9400	9375	9348
768	9709	9688	9666	9645	9623	9601	9579	9556	9533	9509	9485	9462	9436	9411	9386	9360
770	9720	9699	9677	9656	9635	9613	9590	9567	9545	9521	9497	9473	9448	9423	9398	9372
772	9732	9711	9689	9668	9646	9624	9602	9579	9556	9533	9509	9485	9460	9435	9409	9384
774	9743	9722	9700	9679	9658	9636	9613	9591	9568	9545	9521	9497	9472	9446	9421	9396
776	9755	9734	9712	9691	9670	9647	9625	9602	9579	9556	9532	9508	9483	9458	9433	9407
778	9766	9745	9723	9702	9681	9659	9636	9614	9591	9567	9544	9520	9495	9470	9445	9419
780	9777	9756	9735	9714	9692	9670	9648	9625	9602	9579	9555	9532	9506	9481	9456	9430

TABLE 5.

Factor for Reducing Volume of Gases to Standard Temperature and Pressure, Dry; Including Reduction of Barometric Height to Standard Temperature (brass scale).

	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
700	0.855	851	847	842	838	834	829	825	821	816	812	807	802	797	793	788	783	778
702	857	853	849	845	840	836	832	827	823	818	814	809	805	800	796	790	785	780
704	860	856	852	847	843	839	834	830	825	821	816	812	807	802	797	792	787	783
706	862	858	854	850	845	841	837	832	828	823	819	814	810	804	800	795	790	785
708	865	861	856	852	848	843	839	834	830	825	821	816	812	807	802	797	792	787
710	867	863	859	855	850	846	842	837	833	828	824	819	814	809	804	799	795	790
712	870	866	861	857	853	848	844	839	835	830	826	821	817	812	807	802	797	792
714	872	868	864	859	855	851	846	842	837	833	828	824	819	814	809	804	799	794
716	875	871	866	862	858	853	849	844	840	835	831	826	822	816	812	807	802	797
718	877	873	869	864	860	856	851	847	842	838	833	828	824	819	814	809	804	799
720	880	876	871	867	863	858	854	849	845	840	836	831	826	821	816	812	807	802
722	882	878	874	869	865	861	856	852	847	843	838	833	829	824	819	814	809	804
724	885	880	876	872	868	863	858	854	849	845	840	835	831	826	821	816	811	806
726	887	883	879	874	870	866	861	856	852	847	843	838	833	829	824	818	813	808
728	890	886	881	877	872	868	863	859	854	850	845	840	836	831	826	821	816	811
730	892	888	884	879	875	871	866	861	857	852	847	843	838	833	828	823	818	813
732	895	890	886	882	877	873	868	864	859	854	850	845	840	836	831	825	820	815
734	897	893	889	884	880	876	871	866	862	857	852	847	843	838	833	828	823	818
736	900	895	891	887	882	878	873	869	864	859	855	850	845	840	835	830	825	820
738	902	898	894	889	885	880	876	871	866	862	857	852	848	843	838	833	828	822
740	905	900	896	892	887	883	878	874	869	864	860	855	850	845	840	835	830	825
742	907	903	898	894	890	885	881	876	871	867	862	857	852	847	842	837	832	827
744	910	906	901	897	892	888	883	878	874	869	864	859	855	850	845	840	834	829
746	912	908	903	899	895	890	886	881	876	872	867	862	857	852	847	842	837	832
748	915	910	906	901	897	892	888	883	879	874	869	864	860	854	850	845	839	834
750	917	913	908	904	900	895	890	886	881	876	872	867	862	857	852	847	842	837
752	920	915	911	906	902	897	893	888	883	879	874	869	864	859	854	849	844	839
754	922	918	913	909	904	900	895	891	886	881	875	872	867	862	857	852	846	841
756	925	920	916	911	907	902	898	893	888	883	879	874	869	864	859	854	849	844
758	927	923	918	914	909	905	900	896	891	886	881	876	872	866	861	856	851	845
760	930	925	921	916	912	907	902	898	893	888	883	879	874	869	864	859	854	848
762	932	928	923	919	914	910	905	900	896	891	886	881	876	871	866	861	856	851
764	935	930	926	921	916	912	907	903	898	893	888	884	879	874	869	864	858	853
766	937	933	928	924	919	915	910	906	900	896	891	886	881	876	871	866	861	855
768	940	935	931	926	922	917	912	908	903	898	893	888	883	878	873	868	863	858
770	942	938	933	928	924	919	915	910	905	901	896	891	886	881	876	871	865	860
772	945	940	936	931	926	922	917	912	908	903	898	893	888	883	878	873	868	862
774	947	943	938	933	929	924	920	915	910	905	901	896	891	886	880	875	870	865
776	950	945	941	936	931	927	922	917	912	908	903	898	893	888	883	878	872	867
778	952	948	943	938	934	929	924	920	915	910	905	900	895	890	885	880	875	869
780	955	950	945	941	936	932	927	922	917	912	908	903	898	892	887	882	877	872

This chart has been found valuable by our dietitian, Miss Foley, in quickly calculating the patient's daily food requirement. By its use, a high, average or low caloric diet for any individual may be determined with exactness and rapidity.

SUMMARY.

1. The reasons for our preference of the gasometer method of indirect calorimetry for clinical work are briefly given.
2. A series of nomographic charts are described by which the calculation of basal metabolic rate from the data obtained by the gasometer method can be made graphically in less than five minutes without the use of logarithms.
3. The methods of construction and use of nomographic charts are given.

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THE HOSPITAL AS A DIAGNOSTIC CENTRE.*

By ERNEST L. HUNT, M.D., WORCESTER, MASS.

THE many recent attempts at legislation tending to socialize medicine evidence a feeling abroad in the land that the full possibilities of medical science to alleviate the physical distresses of mankind are not being fully realized. The inadequacy of the practice of medicine as at present organized, to reach all sufferers with its full measure of relief, is recognized, and it is quite natural that the lay student of the situation should attribute the cause to lack of ability to pay for the services of a doctor or to a niggardly spirit which urges people to refrain from calling a doctor until too late rather than to spend the amount of the fee, as he thinks, needlessly.

The lay student and the legislator who seek to devise a remedy are apt to start with the premise that to provide the patient with the resources of medical science, it is only necessary to provide the means of having a doctor and, perhaps, a nurse; in other words, they regard the fee as the great obstacle to adequate service, and so by various insurance devices they contemplate its removal.

If the premise were wholly, as we must admit it is partly, true, and the remedy so simple,

*Read before the Worcester District Medical Society at a meeting held in the Out-Patient Building, Worcester City Hospital, April, 1921.

there would yet remain the difficulty of providing the means to pay the fees and the organization to administer the distribution of the calls and the fees, all of which opens such vast possibilities of inefficiency, graft, bureaucracy, taxation and meddling in the private affairs of both patient, doctor and citizen, as fortunately to appall the average taxpayer. The costliness and inadequacy of the Government's attempt to care for the disabled soldiers is a splendid object lesson in this relation.

But as we well know, the premise is, to say the most for it, but partly true. Today in Massachusetts, the standards provided by law are so low and the title "Doctor," with legal right to practice, have been so easily acquired that, as regards the degree to which the practitioner is representative of and capable of expressing the best in medical science, one can only say that there is wide variation and, indeed, that about the only thing the different groups of practitioners have in common is the right to practice under the law.

Moreover, the second part of the premise is defective inasmuch as by far the greatest reason for neglect to seek the advice and aid of the physician lies in the lack of popular knowledge of conditions which call for the help of a medical advisor, to say nothing of the superstitious preferences for various forces of quackery, of prejudice and folly. How common is the patient who neglects or maltreats an infected wound under the delusion that his particular flesh possesses unusual healing power!

So it has come about that the better elements of our profession as represented by our state societies, are generally opposed to so-called health insurance, but as yet are unprepared to meet the propaganda of the proponents with counter propositions of greater or more evident merit.

I claim no originality in perceiving the need of a program on the part of established institutions to meet the new demands. Boston Dispensary, with its "health," and Massachusetts General, with its "consultation" clinics, are in mind as I write. Warbasse, in his recent textbook, devoted a chapter to the economies of surgical practice, in which he dwells upon possible developments to this end. Throughout the state and nation, vast plans for improved medical schools, health departments, etc., are now being made and realized. The custom of group practice is spreading rapidly and is destined to partially answer the question as to how the patient of moderate means can secure the services of the specialists his case may demand.

In our older communities, however, this innovation does not take root so rapidly and, indeed, there would still remain a large percentage of the population unable to avail themselves of the group idea unless it were organ-

ized on a scale of sufficient financial strength to take in all applicants, regardless of how much they can pay.

So it seems to me that to meet the new conditions we must have recourse, at least for the present, to existing agencies, and it seems very possible to enlarge the scope of work in such institutions as our Worcester Hospitals in a way that shall, for the communities served, greatly broaden the distribution of the benefits which medical science can bestow upon the sick.

From our general knowledge of local conditions, it seems fair to assert that, so far as treatment is concerned, practically anything may be had in this community. In certain lines of therapeutics, I grant that there is room for considerable development, as in physiotherapy and, of course, all of us need more skill in our particular lines, but speaking broadly, we are well organized and equipped for treatment of the sick.

There remains, then, the great field of diagnostics, and here, to my mind, lies the great opportunity for improvement. Obviously, it is impossible for the individual practitioner to have the material equipment, special training, or time, to offer his patients the benefit of modern laboratory methods for the diagnosis of disease or injury. To send his patient of the industrial classes from one specialist to another for various examinations, consumes the fees which should be his for the actual care which is likely to be needed. The natural result is that the patient, in many instances, goes without these aids until the therapeutic efforts fail or a bad result ensues, when, perhaps, he is obliged to come into the hospital as a free patient.

Now, perforce, our hospitals must have the physical equipment and trained workers to live up to the requirements of modern diagnostics, and I think it is rather sad to say that, for the most part, they are maintained for the benefit of the very poor, the casual accident case, those who are insured under the Workmen's Compensation Act, and some few well-to-do who enter as private patients.

To me it seems of the utmost importance that the facilities for diagnosis provided by such an institution as Worcester City Hospital be opened to the public in general by a system of graded charges and of confidential reports to the referring physician such as will secure to both the patient and the physician the satisfaction of continuing their relation on the basis of correct diagnosis, and consequently of adequate treatment.

It may not be out of place at this point to briefly summarize the resources of this hospital which are being constantly utilized for the benefit of its patients.

Urine. Chemical, microscopical, cultural, function tests, detection of poisons.

Pus and Other Inflammatory Fluids. Cultural, microscopical, chemical. Also preparation of autogenous vaccines.

Sputum. Cultural (pneumococcus typing), microscopical, as for T.B.

Blood. Usual examination for the anemias and parasites, coagulation tests, grouping for transfusions, Wassermann, and other complement fixation tests, precipitin tests, blood chemistry.

Pathological Material. Histological examinations, chemical tests when needed.

Gastric and Duodenal Contents and Feces. Chemical, microscopical.

Spinal Fluids. Cell counts, Wassermann, Lange, Noguchi, etc.

X-ray. A powerful installation for all manner of diagnostic work, with technician constantly in charge.

Electrocardiograph. A valuable adjunct to cardio diagnosis, under charge of a competent specialist.

Basal Metabolism. A useful method in thyroids and a few other conditions.

Sensitization Tests to animal and plant proteins as basis for treatment of asthma, hay fever, etc.

Cystoscopy. This, in conjunction with the x-ray and general laboratories, renders the diagnosis of bladder and renal conditions a matter of a beautiful precision.

Bronchoscopy and Esophagoscopy, in charge of a competent specialist.

These facilities supplementing careful history taking and general physical examinations, afford exhaustive means of arriving at a true concept of the patient's condition.

You will ask, "How may we avail ourselves of these helps to our patients?"

In order to develop this work, we have in mind two new provisions, viz.,

1. A short period of residence in the hospital for a complete "work up." For special cases, such as thyroids and diabetes, a special section of the private ward, with all graduate nursing service, is authorized. Other patients may be received in either private ward or the general wards, according to their preferences and means. As soon as the diagnosis is arrived at, or our methods exhausted, the patient will be returned with full report, to the physician referring.

2. For the patient who is able to remain at home and come to us for the studies, the work can be done by appointment. This beautiful Out-Patient Building now stands idle daily after 2 P.M., except Wednesday evenings, and it is part of my hope for the development of this idea to utilize it afternoons and evenings for the purpose of a diagnostic consultation and health clinic wherein the patient shall be charged only such fees as he is able to pay, and receive the full benefit of the diagnostic resources of the institution, thereby making it the servant of

all the people and all the physicians. Whether I am correct in my vision of this greater service, you alone can show me. Whether to embark on such a plan or not, may be determined by the way you physicians react to it; but should you, by person or letter, show approval I believe the authority and the means can be provided. For the present, such work must be handled by appointment through the hospital office.

In conclusion, I wish to urge that all public hospitals in Massachusetts adopt a system whereby their diagnostic facilities shall become available for all classes of citizens to the end that greater service shall be rendered and the trend toward greater socialization in medicine shall be guided by the trained intellects in our profession rather than thrust upon us by those unfamiliar with and without sympathy for the best developments of medical practice.

THE RESIDENT SURGEON AND THE HOSPITAL.

BY DONALD S. ADAMS, M.D., WORCESTER, MASS.

THE resident surgeon, or physician for that matter, is not a necessity. There are a number of excellent hospitals in this country where such an office has not been established and yet their standards are high and their reputation the best. To conform with the requirements laid down by the American College of Surgeons, a resident is not a requisite. But in spite of this fact, the man who makes good as resident becomes an asset rather than a mere addition to the administrative force.

What are the qualifications of a resident? He should be a graduate of a recognized medical school and hospital and at the latter he would best have had a general service. The single man is the better, for a resident must live at the hospital and be prepared to put his undivided attention into the work laid down for him. And, above all things, he must be ambitious and wide awake, for the opportunities of slacking up and entering a rut make their frequent appearance.

He comes in constant contact with three forces that always present themselves within the four walls of a hospital, namely the administrative force, the staff, and the house officers. With the former he must, to a certain extent, consider himself a part, and therefore make himself familiar with the rules of the hospital, observe them and be willing to help when called upon. Make the superintendent

feel that you have an interest in your institution and desire to see it advance. A valuable ally may thereby be obtained. His position in regard to the hospital staff is a peculiar one. Although not a member of the staff, he still is closely related to that body and their proceedings must be of vital interest to him. It is best to move slowly at first, noting each man's peculiarities, and then enter into things as the proper time arrives. Their confidence may be obtained and held by an evidence of his desire to fulfill all duties faithfully. And lastly, the house officers. The resident is supervisor of house officers and directly responsible for their work. So he must gain their confidence as well, teach them all he can, get some operative work for them and personally assist them, all with the understanding that they must perform their duties thoroughly. He should instill into their minds the fact that their appointment is to their sole advantage, and off-duty time must be considered only when all work is completed and they can be of no further assistance to the staff. It is also his duty to straighten out any misunderstandings that may arise among them. It might be well to state here that it is an established fact that the first resident in an institution meets with a certain degree of antipathy from the existing house officer regime and cannot hold the controlling hand until they have passed on.

The duties of the resident are not the same in any two hospitals. Thus, in a hospital of 200 beds or under, a man should be able to keep in touch with the proceedings of all the services, including medical, surgical and obstetrical. In the larger hospitals, a staff of residents are required. But it is of the first-mentioned type of institution that I desire to talk. Memorial Hospital has 200 beds, and the resident makes rounds twice a day, morning and evening. Medical and obstetrical cases are studied by him only when a member of the staff asks him to, in case of emergency, or to help the house officers in charge. He thereby has a working knowledge of the cases on hand. At the same time, records are inspected to see that the routines are being carried out, that the histories and four day notes are up to date, and provisional diagnoses written. The surgical side are supposed to have made their provisional diagnosis by the end of 24 hours after admission, and the medical side

are allowed 48 hours. On certain nights, the resident and house officers inspect charts together, and in addition, the surgeon-in-chief looks over all the charts with the resident. In this way the paper work is kept up to date.

Discharge cards may be signed by the resident and care is taken by him to see that they are properly filled out and classified.

Each night the resident books the operations to be done the following day. He lists the type of operation, patient's ward and the operator's name with the time he is to operate. One copy is placed on a bulletin board on the wall of the administration building and another on the same kind of a board in the staff room of the surgery. The bulletin boards not only serve that purpose but, in addition, are used for the posting of notices and slips for the members of the staff, calling their attention to the fact that they are wanted in consultation. These slips are dated and the resident watches this board, and when a man does not take down his slip his attention is again called to it. In this way, a perfect record for the filling of consultation requests has been obtained.

The staff meets each Saturday noon and the surgeon-in-chief acts as chairman, and the resident records in a book the proceedings and attendance. At these meetings the mortalities of the preceding week and any business of interest to the staff are discussed.

The nursing faculty may call on the resident, if they see fit, to care for the nurses when they are ill.

The advantage of a residency to a young man are manifold. Alone, the opportunity of working with the surgeon-in-chief and caring for his cases is more valuable than any other training. To assist an experienced man, talk with him, and watch his methods of procedure, are worth years of ordinary hospital work or inexperienced practice.

The opportunity to assist the other surgeons gives the resident a chance to see others operate, and at the same time improve in his own technique. Many dressings may be done on the wards and among such private cases as the man in charge of the cases sees fit to turn over. This is no small item, for the after-care of cases and their dressings are of vast importance. Emergency work, including fractures and dislocations, offer a chance for the

resident to apply splints and casts and at the same time study x-rays. As the members of the staff see he is in earnest and is capable, they give to him operations of more major character until the resident is getting his share of the ward operating, which is as much as any young man could ask for.

And lastly, the question of financial remuneration comes up. The salary of a resident varies in different institutions, from five hundred to fifteen hundred dollars a year, together with his living expenses. To the man who plans to enter private practice later on, this income, put away in the bank, will be highly appreciated.

In conclusion I would like to consider what the resident may do to help maintain the hospital standards. I have already mentioned his care of the charts, attempts to see that the consultation requests are filled, operations booked in such an order that friction is avoided, and general supervision over the house officers. One more point remains, namely, the care of the monthly hospital analysis. In Memorial Hospital, every attempt is made to live up to the American College of Surgeons standards. Dr. Homer Gage, Surgeon-in-Chief, planned a monthly report or analysis of the hospital services, using a modification of the one designed by the College. He calls upon the resident to analyze the cases each month and when the report is completed, he reads it at staff meeting, and an interesting discussion follows. There is no better way of bringing up before the staff a review of the preceding month. It is an excellent opportunity for the resident to go over the records, admission and discharge cards and end results cards. When it is complete, the following points have been ascertained:

1. Number of acute abdominal cases entering hospital, with the diagnosis, name of operator, time between admission and onset, and time between admission and operation.
2. Number of admissions to hospital. Number discharged cured, relieved, and dead.
3. Consultations: number asked and obtained, asked and not obtained, and finally indicated and not asked.
4. Diagnosis: number of provisional and final diagnoses that agree, number that disagree. Number of cases discharged with no diagnosis, and number of those discharged with added diagnosis.

5. Institutional infections—medical, surgical and obstetrical, giving the type of infection, name of attendant and ward. This brings out the occurrence of stich abscesses, post-partum infections and contagious diseases.

6. An itemized list of the cases discharged unimproved, with the name of the attendant and the number of days patient was in the hospital.

7. Average number of days of discharged patients. Number of those staying in the hospital more than three weeks, and number of patients now in the hospital more than one month.

8. Itemized list of the causes of death.

9. Number of deaths on (a) Medical Service, (b) Surgical Service, and (c) Obstetrical Service. Also the number of autopsies obtained on these services.

10. Analysis of obstetrical services, showing the number of normal deliveries performed by each obstetrician and then in turn the number of instrumental deliveries each man resorted to. Obstetrical complications are noted, with their treatment and the ultimate result obtained.

11. List of Caesarean sections performed, with name of operator, assistant, ward, and indication for so doing.

12. Those cases discharged with no diagnosis, giving the name of the attendant and his reason for not arriving at some diagnosis.

Considering the various points brought out in this paper, it is fair to assume that a residency is worth any man's time. By conscientious work and following the guide of a competent surgeon-in-chief, he may be of real value to the hospital.

EXTRAPLEURAL RESECTION AND PLASTIC OF THE THORACIC ESOPHAGUS. AN ORIGINAL METHOD. REPORT OF SUCCESSFUL CASE WITHOUT GASTROSTOMY.*

By HOWARD LILIENTHAL, M.D., F.A.C.S., New York.

Author's Abstract.

This operation was devised to minimize the danger of septic mediastinitis. It was recognized that before opening the esophagus the mediastinum must be sealed off by a healing process which should have advanced to the stage of granulation.

* Read before the American Surgical Society, at its meeting in June, 1921, in Toronto. To be published in full in *The Annals of Surgery*.

The patient was a 35-year-old man with a partially obstructing squamous cell carcinoma below the arch of the aorta. At the first step, the operator lifted a skin flap about three inches in width and 10 inches in length which was outlined by an incision beginning at the eighth interspace close to the spine, passing obliquely forward parallel to the ribs, thence downward and then backward to a point about three inches below the place of beginning. This flap was used in fashioning the new esophagus to take the place of the resected part. A six-inch subperiosteal resection of the ninth rib was then made and the pleura stripped forward away from the posterior mediastinal region. The eighth, seventh and sixth ribs were cut through near their spinal attachments after peeling the pleura away and then the tenth rib also was divided. The pleura could now be pushed forward, exposing the organs within the mediastinum through a wound large enough to permit the surgeon to work with both hands in its depths. With a stomach tube in the esophagus, this structure was easily identified and stripped from the pleura and aorta. The fibers of the plexus gaulae of the right vagus were divided. The fusiform swelling which marked the tumor within the gullet was about an inch and a half below the arch of the aorta. The skin flap was placed in to wound so that it partly encircled the mobilized esophagus, the cutaneous surface toward the viscera. This first step of the operation was concluded by packing the wound with gauze. The patient could swallow fluids. Two weeks later, without anaesthesia of any kind, the wound was spread apart and the tumor-bearing section of the esophagus was resected. Nourishment was now given through a stomach tube passed into the lower esophageal opening and later through an Elnhorn tube passed from mouth to stomach through the gap left by the resection. The pedicle of the skin flap was cut across in another week. There was later contraction of the cicatricial tissue at the mucocutaneous margins, making it necessary to divide the strictures by stellate incisions and thereafter bougies were passed frequently. The final step was to close the posterior esophageal opening by suture and to make a plastic operation to cover the defect in the patient's back with skin by the use of sliding flaps. A few days after this final procedure, liquids could be swallowed without leakage, and soon all wounds were healed and any soft food could be taken normally.

A number of drawings were made at the operation and are reproduced in the article. There are also roentgenograms and a photograph.

Other cases in which this exposure was made are reported but all proved inoperable. The conclusions are as follows:

1. That transpleural resection of the esophagus has a forbidding mortality.
2. That fatal infection follows the primary opening of the esophagus within the mediastinum.
3. That it is feasible to make an extrapleural exposure of the posterior mediastinum large enough to permit the operator to see clearly and to work safely with both hands.
4. That resection of the esophagus in the posterior mediastinum can be done by dividing the operation into two stages. At the first, the esophagus is freed from its attachments and the mediastinum is sealed. At the second, 10 to 14 days later, the resection is performed.
5. This procedure deserves a fair trial by thoracic surgeons.

Book Review.

General Pathology. By HORST OERTEL. New York: Paul Hoeber, Octavo, 331 pages. Price, \$5.00.

It is probable that the reviewers' comments on this work might have been less severe had the author's pretensions been less high. The book is said to be "an introduction to the study of medicine, being a discussion of the development and nature of processes of disease." There is a dedication, a foreword, a preface, an introduction to each of the two parts of the book, and an epicrisis, all of which seem to us somewhat self-laudatory. The dedication tells us that the book is "a record of the combined efforts of all nations to arrive at the truth in one branch of science." The foreword that "pathology must be approached within the frame of modern biology, and that in the study of disease no less than in the study of health scientific vision is possible only if we divest ourselves of all metaphysical and teleological conceptions of use, harm, defense, vital forces, conscious purpose, etc., and treat pathological processes entirely as expressions of physico-chemical laws." That the author has attempted to "bring together in . . . a concise, comprehensive, connected and readable form, facts and considerations upon which modern pathology rests."

That one of the author's purposes "was to visualize as much as possible pathological occurrences, and therefore great emphasis has been put on the anatomic-histological formal side from the dynamic standpoint."

In the preface there is a brief historical sketch of the development of pathology, and a final statement that: "It is to be noted that pathological anatomy and histology differ from normal anatomy and histology in being not only descriptive but eminently explanatory of the character of disease. For, being representative stages of a disease at a certain time, they collectively disclose the whole formal genesis, that is, the manner of development and the history of a disease."

In the epicrisis he tells us that "the effort has been confined to make it clear that pathological processes (diseases) are physical and chemical cell alterations, and disturbed cell relations which follow common biological laws and that in the majority of instances, at least, find a definite anatomical expression."

The book itself occupies three hundred and thirty octavo pages, ninety-four of which are devoted to ordinary descriptions of the commoner pathogenic bacteria and protozoa; descriptions such as one could take from any textbook in bacteriology, but in this instance not particularly well chosen. Eight lines are de-

voted, for instance, to the description of the capsule of the pneumococcus, and only ten lines to the question of types of pneumococci, after which the reader is left with the inference that the types of pneumococci are recognized "as distinct in certain cultural characteristics and virulence." Nothing is said about agglutination and precipitin tests as used in typing pneumococci. We are informed that the fourth type "is a relatively virulent form which is common in the mouths of healthy persons." Spirilla and spirochaetes are grouped together. Protozoa are given four pages and a half. Trypanosomes and the parasites of malaria occupy four pages, the filterable viruses a half page; but he does not mention in what diseases filterable viruses are encountered other than poliomyelitis. Twenty-nine pages are devoted to a treatment of immunity, written about as adequately as the bacteriological section. There is a section on physical and chemical factors as a cause of disease, in which temperature, air-pressure, electricity, x-rays, radium and poisons are treated in a catalog-like fashion.

Part 2, on the internal factors of disease, has chapters on disposition and idiosyncrasy and heredity.

Book II contains one hundred and fifty-four pages, and is entitled "Pathological Anatomy and Histology and Pathogenesis." Here again we have a condensed catalog-like account of pathological processes, not quite so well done as in many text-books of the last thirty years, and presented in about the same order to be found in most text-books; the same account of atrophy, the degenerations, the infiltrations, pigments, etc. Inflammation and the tumors follow, and so on through the list.

One can take exception to the author's descriptive terms as applied to histology; for example, in speaking of the histology of tuberculosis, in which he compares the process to granulation tissue, he says that "it displays from the start an unfinished, unhealthy appearance which can be attributed to avascularity and the toxic action of the bacilli on the proliferating fixed tissue cells"; he refers to connective tissue fibrils which "swell and appear rigid," new tumor cells which "appear more supple."

On the whole, the book is not bad, but on the other hand, it has no particular merit, and therefore no justification. It reads like a set of lectures delivered before students of elementary pathology. There are no illustrations, and no references are given for the original work referred to in the text. While the book probably covers the ground of the course in pathology given at McGill, the general reader will find it very disappointing, particularly if he reads the promises of the dedication, the foreword and the introduction.

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DR. HUNT'S PAPER.

IN Dr. Ernest L. Hunt's paper, appearing on page 354 of this JOURNAL, the preamble lays down the proposition in substance that medicine as organized at present fails to provide full measure of relief to sufferers. While this is so to a certain extent in emergency service one may fairly contend that medicine has progressed as rapidly as may reasonably be expected under human administration. Many persons will die by accident or be irremediably maimed under very much better organization, but those cases which are within the scope of possible benefit can secure all that medicine can offer, if continuously under competent observation. The difficulty lies more generally in the lack of judgment of the sufferer in seeking help, or perhaps less often in failure of the medical attendant to secure thorough investigation of his clients.

It is exceedingly unpopular to even refer to the low grade work done by a minority of the profession, because some very well qualified practitioners resent the imputation and feel that those who try to correct faulty methods are discrediting medicine itself. Dr. Hunt makes the issue and plainly states that there is wide variation in the quality of medical practice. His solution for his community is logical and

practical and should lead to the utilization of the plant which he refers to. In the manufacturing business a plant which is idle a large proportion of the time would not stand competition, and a plant designed to cure disease ought to work at least full time so long as there is human need.

As stated in the paper, the solution of the problem lies very largely in the hands of the profession, for if it can be shown to the trustees of the Worcester City Hospital that the profession will take advantage of the facilities which may be made available for all in that section of the state, there is the greatest probability that the plant will not be allowed to lie idle so much of the time. Because the hospital is not a money making institution there is no excuse for failure to meet the fullest measure of efficiency. Health is of greater value than money.

Such development of practice should not be restricted to the Metropolitan district, for every hospital could increase its usefulness by the plan suggested by Dr. Hunt, and thereby forestall other plans which are less likely to be productive of good, and which have dangerous possibilities. If Worcester makes an impressive showing, other places will be led to develop the same plan.

MATERNITY LEGISLATION.

UNDER date of September 10 inst., The Massachusetts Civic Alliance has distributed a circular and a letter relating to the Sheppard-Towner Bill. In the letter it is claimed that the "forces of destruction are hiding behind the women. Many of these women workers do not know that they are cats'-paws for Trotsky and Lenin to wreck the U. S.," and later suggests that the President of the United States will be open to Republican Counsel after raising the question, "Cannot the President be aroused?"

In the circular the Alliance claims that Madam Kollontai is supporting the bill for the purpose of making all children wards of the State and destroying the present form of family life in the interest of communism.

The Alliance professes to be non-partisan, but adopts distinctly partisan methods in appealing to Republicans for the use of influence with the President and Congress. An appeal of this nature weakens a cause which has abundant material for logical argument, and which should be dealt with as an important measure calling for solution by all intelligent people. There are many in both of our great parties who are unselfishly devoted to all questions which should rise above party interests and this is one of them. The injection of party influence into a matter concerning the health and lives of women and children is distinctly

a bad policy and tends to dissipate effort which might be coordinated for the public good.

As for Madam Kollontai, whether she is working for the communistic principle or not, the marriage institution is entrenched in this country and propaganda designed to wreck it will have a very small minority in its support. The National Mann Act and the Massachusetts laws are fairly good indices of the public attitude.

Rather than introduce politics into this discussion, the better plan would be to rely on appeals to intelligence in deciding a measure of this magnitude. Whether some women may or may not be duped, the spirit of our American institutions is strong among them as a class and these questions must be decided upon merit. History shows that the masses in this country are not often on the wrong side for very long, and one may reasonably have faith that good judgment will be exercised in the end.

So far as the question applies to physicians, our part lies first in the development of the highest type of professional service in dealing with the dangers of maternity and child life, and second, in putting our interpretation of the questions involved before the law makers with cogent arguments based on realities, both for good and against the bad measures.

The arguments alleged to have been put forward by Dr. Haven Emerson, Medical Advisor of the Veterans' Bureau, would it is feared, apply to the administration of the features of the Sheppard-Towner Bill. According to Dr. Emerson, the Veterans' Bureau has become a football of politics which led him to resign his connection with it. He is reported to have asserted that unnecessary salaries to the extent of \$500,000 a year are being distributed for political patronage in that department. If the Government can play politics with the sacred obligation which this country is under to provide all proper measures of relief for our soldiers, it is just as likely to play politics with the lives of women and children. Washington is too far away from Massachusetts for the administration of the machinery necessary in the study of our maternity and infant welfare problems. It will be soon enough to transfer our responsibilities when we are ready to concede our decadence.

CONFERENCE OF NATIONAL AND NEW ENGLAND TUBERCULOSIS ASSOCIATION OFFICIALS.

Officials of the National and New England Tuberculosis Associations met in the Little Building, Boston, September 7, 1921, for conference. Dr. H. A. Pattison of New York presented certain principles involved in the standardization of the treatment of tuberculosis, for

since hospitals can never provide a sufficient number of beds for all cases, treatment should be formulated so as to become more uniform and adapted to home conditions. In many cases sanatorium treatment has accomplished all that it is designed to bring about and at time of discharge a home can be prepared under the direction of a public health nurse suitable for the care of the patient, with the understanding that further treatment should be conducted by the physician, aided by the public health nurse. The standards of medical care should cover all hygienic rules, leaving the physician free to apply recognized methods without the use of "nostrums" or experiments. Monthly reports should be made of the condition of the patient until the patient had been able to resume his usual occupation. In this way valuable data could be collected and end-results tabulated.

Dr. Pattison said that "tuberculosis is not beaten by any means, but the fight that has been waged means a reduction of seventy-five thousand deaths a year."

All the New England States were represented with the exception of Maine.

MEDICAL NOTES.

ACCORDING to a bulletin recently issued by the Metropolitan Life Insurance Co., the health conditions prevailing among the wage earning groups of the United States and Canada for the first quarter of 1921 were the best that ever have obtained during this season of the year. The span of man's life is now "three score years and fourteen," according to Dr. George W. Hoglan, secretary of American Insurance Union. Dr. Hoglan says careful investigation shows the average life has been lengthened four years, in spite of added risks and perils of the twentieth century.

DR. M. VICTOR SAFFORD, epidemiologist in the Boston Board of Health, has been appointed Deputy Commissioner of Health of Boston. Dr. Safford has had a long and valuable experience in the United Public Health Service.

DR. A. VINCENT SMITH, of Middleboro, has been reappointed as associate medical examiner of the fourth Plymouth District.

WEEK'S DEATH RATE IN BOSTON.—During the week ending September 10, 1921, the number of deaths reported was 161 against 162 last year, with a rate of 11.08. There were 26 deaths under one year of age against 41 last year.

The number of principal reportable diseases were: Diphtheria, 27; scarlet fever, 13; mea-

ales, 16; whooping cough, 8; typhoid fever, 2; tuberculosis, 31.

Included in the above, were the following cases of non-residents: Diphtheria, 9; scarlet fever, 1; whooping cough, 4; typhoid fever, 1; tuberculosis, 5.

Total deaths from these diseases were: Diphtheria, 4; whooping cough, 2; typhoid fever, 1; tuberculosis, 15.

Included in the above, were the following cases of non-residents: Diphtheria, 3; whooping cough, 1; typhoid fever, 1; tuberculosis, 1.

REGULAR MEETING OF THE WORCESTER DISTRICT MEDICAL SOCIETY was held at 4.15 P.M., Wednesday, September 14, 1921, at Worcester State Hospital, Summer Street. Communication—"Mental Hygiene," Dr. William Alvin Bryan, Worcester State Hospital. The subject of a union meeting with the Worcester North District was brought up for discussion.

THE COMMITTEE previously appointed to recommend plans for meetings for the ensuing year made a report, and it was voted to hold evening meetings in September, October, November, March and April, and in the afternoons in January and February.

It was voted to arrange for a union meeting with the Worcester North District, according to request of the committee appointed by the Council, the details to be arranged by the Secretary in conference with the representative of the Worcester North District.

Dr. Bryan's paper was a forceful and logical presentation of the necessity of more general understanding of the problems incident to mental deviations by the general practitioner and claimed that inattention to early symptoms often resulted in more or less permanent mental disease. He felt that preventive measures should be employed early in life, both in the family and in schools, and that practitioners could accomplish very much in dealing with parents as well as with children who are drifting into abnormal mental habits. The arguments and illustrations presented created great interest, as shown by the discussion following the paper. Dr. Bryan entertained the Society at a luncheon served after the adjournment of the meeting.

THE METROPOLITAN LIFE INSURANCE STATISTICS show a tuberculosis death rate of 137.9 per 100,000 lives; organic heart disease, 117; pneumonia, 106; Bright's disease, 70; cancer, 69; cerebral hemorrhage, 61; diphtheria, 22.1. Typhoid, with a rate of 6.7, sustains the designation of the vanishing disease. The statistics of this great company are generally accepted as fairly representative of conditions throughout the country.

THE PUBLIC ATHLETIC LEAGUE of Maryland conducts systematic medical examinations of pupils of the public schools of the cities of that state and wherever a child is found to be free from physical defects a "health first" button (white) is given, and in addition a letter is sent to the parents of such children complimenting them for the care and interest taken. A green button is given to a child found to be in need of remedial care. The annual report shows that 28 per cent. of the boys and only 12 per cent. of the girls were entitled to the white button.

COLLEGE-BRED WOMEN live longer than uneducated women according to a study made by Myra M. Hulst of the American Red Cross. The death rate among college graduates between the age of 25 and 34 was 2.77 per one thousand, but it was 6.10 for women in the general population.

DR. GEORGE H. HOOPER has been appointed resident anæsthetist, and Dr. William R. Supple resident surgeon at the Boston City Hospital.

SPRINGFIELD ACADEMY OF MEDICINE.—The regular meeting of the Springfield Academy of Medicine was held at 137½ State Street, Tuesday evening, September 13, 1921, at 8.30 o'clock. Dr. Charles H. Lawrence of Boston read the paper of the evening entitled "The Practical Value of Basal Metabolism." The committee on the revision of the Constitution and By-Laws made its report.

A JOINT MEETING of the Hampshire-Franklin District Medical Societies at Lathrop Hotel, South Deerfield, Mass., was held Wednesday, September 14, at 3.30. Dr. Leslie H. Spooner of Boston, read a paper on "Neuro-Syphilis—Diagnosis and Treatment." Dinner was served after the meeting.

DR. JOHN M. MATHER, Pres.
DR. CHAS. MOLINE, Sec.

THE MORTALITY RATE from acute rheumatism has declined about 40 per cent. in the last decade. It is claimed that this is the result largely of the elimination of infections in tonsils and teeth. The improved quality of milk probably also enters into this explanation, for with pasteurization and inspection there have been fewer epidemics of septic sore throats. Undoubtedly better understanding of the pathology of rheumatism by physicians has led to more effective treatment.

THE AMERICAN RED CROSS reports that Dr. Russell Stewart Wingfield of Philadelphia, who was seriously burned August 14 in a fire which

destroyed the American Red Cross Children's Hospital, died in Salonika August 20, after a week's fight against shock and nephritis. Funeral services were held August 23 at the American Red Cross headquarters in Salonika, full military honors being paid by a detachment from the Greek regular army. The body will be shipped to the United States for burial.

Dr. Wingfield was 26 years old. He was born in Richmond, Va., where his parents live at 806 Fourth avenue. He went to Europe in February, 1921, for service with the Red Cross, and was immediately sent to Salonika to take charge of the Children's Hospital at Kalamaria Refugee Camp.

When fire broke out in the hospital dispensary on Sunday night, Dr. Wingfield succeeded in saving all the patients and personnel, with the exception of one Greek interpreter. His heroic efforts, however, cost him very severe burns about the face and arms, and his condition had been critical throughout the week.

Dr. Wingfield was a graduate of the John Marshall High School of Richmond, the University of Richmond, and the Medical College of Virginia. He enlisted in the army medical corps immediately on the American declaration of war, and served throughout the war as a State Inspector of Draft Boards. After the war he became a resident physician at the Stetson Hospital in Philadelphia, leaving this post to go to Europe last February.

THE decision upholding the vaccination law resulting from the Haverhill case, is being cited all over this country and is proving of great value in clarifying a situation which was always in doubt previous to the interpretation of the law by the Supreme Court of this State. School authorities and Boards of Health have an effective weapon now in dealing with the objectors of vaccination.

THE U. S. PUBLIC HEALTH REPORTS state that the increase in the prevalence of smallpox in the United States during recent years has been marked and definite, and that Vermont proportionately exceeds other states in the eastern group in the increase. The Vermont law is not compulsory because of organized opposition to better requirements. During smallpox epidemics unvaccinated children are excluded from school and free vaccination is offered. Several Massachusetts epidemics have originated in Vermont.

WEEK'S DEATH RATE IN BOSTON.—During the week ending September 3, 1921, the number of deaths reported was 171 against 195 last year, with a rate of 11.77. There were 38 deaths under one year of age against 54 last year.

The number of cases of principal reportable diseases were: Diphtheria, 26; scarlet fever, 17; measles, 10; whooping cough, 5; typhoid fever, 5; tuberculosis, 46.

Included in the above were the following cases of non-residents: Diphtheria, 4; scarlet fever, 3; tuberculosis, 5.

Total deaths from these diseases were: Diphtheria, 1; whooping cough, 1; typhoid fever, 1; tuberculosis, 9.

Included in the above were the following cases of non-residents: Tuberculosis, 1.

Leprosy, 1 death.

Obituary.

FANNY BERLIN, M.D.

DR FANNY BERLIN, a pioneer woman surgeon of Boston, died at her home in Roxbury, September 4, 1921, at the age of sixty-nine. She was born in Russia and received her education abroad, taking her M.D. at the University of Zurich, Switzerland. Coming to Boston in the late seventies, she became resident physician at the New England Hospital for Women and Children, at that time engaged in overcoming the early prejudices against a hospital that was managed and staffed exclusively by women. Later, Dr. Berlin was made a visiting surgeon and for some fifteen years did much major surgery at that institution. She joined the Massachusetts Medical Society in 1885 and resigned in 1909. Ill health forced her to relinquish active practice about five years ago. She is survived by a nephew and niece who live in Boston.

Correspondence.

MEDICAL WORK IN CHINA.

Hunan-Yale Medical School,
Changsha, Hunan, China,
August 3, 1921.

Mr. Editor:—

In reply to your letter requesting information about medical affairs in Hunan Province, I think a brief history of the growth of the Hunan-Yale Medical School should prove most interesting.

This school is a part of the enterprise known as Yale-in-China by Americans, and as Yall by the Chinese. This enterprise was launched by Yale graduates in 1902. In 1905 Dr. Edward H. Hume was called from his work in India to start a hospital in connection with the academic school. The hospital, academy, and later the college of liberal arts, have had several sites within the city walls of Changsha before moving to their present grounds a short distance outside the north gate of the city.

In 1913 a plan for medical education was formulated and an agreement was made between the Hunan Ru-Chun Medical Educational Association, composed of Hunan gentry, having the support of the Provincial government and the staff of Yale-in-China. The purpose of the agreement was:

1. To maintain in Changsha a hospital for the treatment of disease, and one or more dispensaries.

2. To maintain a medical school of which the curriculum shall be determined after careful study of the regulations of the Board of Education; and to request this Board of Education to depute inspectors to examine the standards adopted.

3. To maintain a School of Nursing for instruction in the art of nursing; and in connection therewith to maintain a department of obstetrics.

4. To maintain a laboratory for the investigation of the causes of disease.

Under this agreement, both parties assumed practically equal obligations. The Chinese were to erect buildings for the Medical College and Nursing Schools and to supply the necessary money for running expenses, not to exceed \$50,000 (Mexican) annually. Yale-in-China was to erect the hospital and to provide the salaries and expenses of 15 teachers, physicians and nurses who were graduates of Western universities. The general expenses, not included under "salaries of foreign staff and expenses of Medical School and Nursing School," were to be met by the Association. Both parties were given equal representation on the Board of Management. The agreement was made for a period of ten years, with the expectation of permanency.

In 1913 the first class of premedical students began and the Nursing School was organized. A spacious Chinese building in the city was given by the government for the Medical School and the original hospital, opened in 1906, was moved to this place and began work as the Hunan-Yale Hospital. Here female patients were seen and the training of women nurses began. Male patients were treated and male nurses received their training at the Red Cross Hospital, also in the city. In 1916 the first class of medical students actually began studies in the medical school.

Soon after this, a plot of 14 acres was bought across the road from the new campus of the college and middle school. Further property is already greatly needed. Through the generous gift of a classmate of Dr. Hume's at Yale, a modern, permanent, fireproof hospital, built to accommodate 120 beds, and capable of expansion to double the capacity, was completed in 1918. All the clinical work, both on males and females, and the training of both male and female nurses was then transferred from the hospital within the city to the new hospital. This hospital has many times proved a haven of refuge in times of political trouble (which are frequent in Changsha) and most of the time it has accommodated patients to its capacity. Last year the total of in-patients was 1,436, which was an increase of about 225 over the previous year. The total of out-patients was 28,111, an increase of 16,150 over the previous year. Whereas a few years ago, one would find that almost all of the patients in a foreign hospital were surgical patients, in the past year, the Hunan-Yale Hospital has had 53% of its total as medical patients.

In spite of the hardships of not being able to get new teachers during the war and the necessity of large amounts of money needed to equip the premedical school, the Medical School has steadily developed. Although under one Governor, payments were curtailed and irregular, the local gentry on several occasions have met the funds to maintain the institution at their own financial loss.

In 1919 the first unit of the permanent medical school buildings was erected. In 1920 a \$50,000 science building, the gift of the China Medical Board, was completed on the campus of the college and the premedical students were transferred to the administration of that faculty.

The medical school course consists of five years, the last year being devoted entirely to clinical clerkships which do not count as internships, although the work is very similar. This last June witnessed the first granting of medical degrees (under a charter of the State of Connecticut), ten graduating in this

class. The enrollment of the medical school proper this last year was 42. Including two new appointees who will be at the language school this coming year, there are 14 members of the staff of the Medical School. A few of the Chinese members of the staff were trained at the Harvard Medical School in Shanghai and all have had further training in America. Dr. Y. C. Yen, a Yale Medical School (New Haven) graduate and who has had graduate work with Dr. Rosenau of Harvard at the London School of Tropical Medicine, is the Principal of the Medical School, and his influence has been considerable in bringing about the cooperative spirit between the Chinese and Americans which has been the strong point of the Yale aim.

A word should be mentioned about the Nursing School, as the training of women in China as nurses is in its infancy and, at present, there is very little nursing of male patients by them. The course is four years and at least one year in a middle school is required for admission. In a short time the requirement will be graduation from a middle school, as there are more applicants at present than can be taken care of. A working knowledge of English is included in the course. The school has graduated 20, and at present there are about 15 men and 21 women students.

Several of the medical graduates of last spring will stay on as internes and, it is hoped, with a few of the more capable men, to send them to America for further study, after they have had a chance to prove their fitness as shown by their work as internes.

To one who has just finished such a course as one gets at the Harvard Medical School and as a Surgical Interne at the Massachusetts General Hospital, it is a delightful surprise to land in the very heart of China and find everyone striving to maintain the same high standards of medical training that we have at home. There naturally are things one would like that one doesn't find when he wants it, but I have heard things called for in vain in the best hospitals at home. We have a goodly number of current magazines, but books are the thing that one would like to see more of. While many things in China are cheaper than at home, books certainly are not, so the Medical School and individuals have to think several times before ordering books.

To anyone who has passed through and seen something of the Hunan-Yale Medical School and the College of Arts and Sciences and the Middle School, there can not help but come the feeling that the large number of Yale graduates at home who have backed the loyal group of men who have helped make this institution out here have built themselves unconsciously into a much bigger constructive and international unifying force than they probably have dreamed they were doing. Respectfully yours,

MORRIS B. SANDERA, H. M. S. '19.

SHEPPARD-TOWNER BILL.

Newton, Mass., Sept. 12, 1921.

Mr. Editor:—

I was much pleased by the brief reference to the Sheppard-Towner Bill in the issue of September 8, and trust that you will not let the matter drop, as no effort should be spared to defeat this bill.

The present is no time to add to our tax bills in trying out fads and our experience with Federal control, as exemplified by the railroads, the shipping board and last, but by no means least, the care of disabled soldiers, is not such as to make us wish to extend it.

Every physician in Massachusetts should do his utmost to prevent the passage of the bill by writing at once to his representative in Congress urging him to oppose it and not only this, but if he has friends in other states, he should write them and urge them to do the same.

FRANCIS GEO. CURRIE.

CONSULTATION CLINICS AND EXTENSION EDUCATIONAL INSTRUCTION FOR DOCTORS.

Mr. Editor:—

New times demand new methods, new agencies and new equipment. This applies to medical efficiency and public health service. It means some reconstruction of the older agencies and affiliation and co-ordination with the newer. The doctor was the first in the health field, then came the nurse. The hospital came as the result of social organization, a means for further diagnosis, treatment and care of the sick. The prestige of association with a hospital has often proven a temptation to those so honored to yield unduly to the public clamor for forms of free service. Hospitals, however, are more or less public institutions and should serve the larger fraternity of doctors rather than the favored few. They serve the public best when an effective working inter-relationship is established with all physicians of good standing in territory tributary to such institutions.

The doctor must be encouraged to keep himself fit and equipped as both a potential and active guardian and conservator of health. The hospital has more and more evolved as a clearing house centre for medical education. This is seen not only in relation to the active study of medicine, but by reason of the stimulus and corrective and collective results which hospital association affords to those in the active practice of medicine. With all the adjuncts required in the range of medical practice today, the hospital furnishes the most economical line of facilities and equipment. Group medicine is a privately organized enterprise for expert efficiency, and in a public way, a hospital may be so regarded. To keep up today, the physician must either provide himself with a costly outfit, or connect up so as to be within easy reach of extensive facilities and equipment. The public, the government, too, is exacting in requirements which are restricting and embarrassing. The physician works best with a certain amount of individual freedom and may prefer not to be simply an employee of state, town or of a business, or social enterprise. If physicians are conscientiously and intelligently serving the interests of the laity individually and at large, the public must ultimately recognize the value of such services and make provision for adequate compensation for the privilege of having such service at hand.

Whenever there are special endeavors put forward in behalf of individual or community health, it is but natural to question the part which doctors play in such movements. The profession is bound more or less by custom and habit from assuming to proffer their services and offices. Since the war, welfare organizations are putting "county" and other nurses into rural districts, and surveys, clinics, health and educational classes are being carried on by these agencies. Complaint is already arising that nurses are encroaching upon the field of doctors and "practicing medicine." Public and charitable enterprise carry the burden of hospital building and upkeep and here we have organizations supporting field workers and doing a form of hospital extension service. The field for medical service comprehending all forms of preventive work, matters of health consultation as well as attendance to sickness and surgical needs is a great and growing one. It would seem as though the effort to promote an affiliation of medical men so as to encourage an extension of their activities might be engineered to the mutual advantage of both the doctors and the laity. Unless the project is to strengthen the position of the profession as a whole, it cannot secure individual co-operation and good will. Our hospital plants can be made to serve a wider field of usefulness in an educational way. This will, of course, involve some reconstructive methods and new adaptations, but the endeavor has been, and should be, jealously to guard the interests

of the laborers and stimulate the public to a wholesome and self-respecting support.

PAUL W. GOLDSBURY.
Deerfield, Mass., September 13, 1921.

TO PUBLIC HEALTH OFFICERS, PHYSICIANS, CLINICIANS, NURSES, SOCIAL WORKERS, AND OTHERS INTERESTED.

Mr. Editor:—

In response to a preliminary announcement of the Public Health Institute, which the Public Health Service had planned to hold in Washington next fall (but which has been postponed indefinitely), a large number of city and county health officers, physicians, nurses and others replied indicating a definite intention or hope of attending.

The Public Health Service has felt that it could not ignore this widespread interest in institute work, and after correspondence with the various state boards of health, has decided to hold a series of twenty-four institutes at various population centers throughout the country.

It is expected that most of the well known specialists announced for the two-weeks' institute in Washington will be on the faculties of two or more of the various local institutes. No tuition fee will be charged.

Last year four times as many persons attended the venereal disease institute as were expected. In order that adequate plans may be made for this series of local institutes, anyone expecting to attend will please notify the Health Service.

Respectfully,

H. S. CUMMINGS, Surgeon-General.

TENTATIVE SCHEDULE OF DATES.

Hot Springs,* October
Jacksonville, November or December
New Orleans, January 9 to 14
Columbia, January 9 to 14
Dallas, January 18 to 21
Birmingham, January 16 to 21
Memphis, January 23 to 28
Louisville, January 30 to February 4
Indianapolis, February 13 to 18
Pittsburgh, February 20 to 25
Lansing, March 6 to 11
Chicago,* March 13 to 18
Los Angeles, 1
San Francisco, 1
Portland, Oregon, April 10 to 15
Kansas City, Kansas, April 10 to 15
Spokane, April 17 to 22
Newark, April 17 to 22
Helena, April 24 to 29
Albany, April 24 to 29
Denver, March 1
A New England City, May 1 to 6
Washington, late in May

* The Hot Springs, Ark., and Chicago institutes will deal only with problems of venereal disease control.

Dr. KENDALL EMMERSON has returned from Europe and will again open an office in Worcester for the practise of orthopedic and general surgery. Dr. Emerson left Worcester in 1916 to join the Harvard Unit and was attached to the British Army for a year. When the United States entered the war he returned to this country and, as a Major in the Medical Corps, was assigned to duty at Washington, D. C. At the close of the war he was made Medical Director of the American Red Cross in Europe, where he has been actively engaged until recently.

The Massachusetts Medical Society

A stated meeting of the Council will be held in John Ware Hall, Boston Medical Library, Wednesday, October 5, 1921, at 12 o'clock, noon.

Business:

1. Nominating Committee nominates and Council elects an orator for 1922, in place of orator elected last May, who cannot serve.
2. Reports of Standing Committees.
3. Petitions for restoration to fellowship.
4. Appointment of delegates to annual meeting of Vermont State Medical Society at St. Albans, October 13 and 14, 1921.
5. Appointment of Auditing Committee.
6. Report of delegation to House of Delegates, American Medical Association.
7. Reports of Special Committees and delegates.
8. Fill Vacancies in Committee of Arrangements.
9. Incidental business.

WALTER L. BURRAGE, Secretary.
Boston, September 28, 1921.

Councillors are reminded to sign the attendance book before the meeting.

The Cotting Lunch will be served immediately after the meeting.

Officers of the Massachusetts Medical Society

1921-1922

PRESIDENT

JOHN W. BARTOL . . . 3 Chestnut St., Boston, 9

VICE-PRESIDENT

BRACE W. PADDOCK . . . 7 North St., Pittsfield

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EDWIN H. BRIGHAM
Brookline, office 5 The Fenway, Boston, 17

Miscellany.

COMMITTEE ON PUBLIC HEALTH.

LECTURERS FOR THE YEAR 1921-1922.

The Committee on Public Health of the Massachusetts Medical Society has been able during the past three years to arrange with well known specialists in various medical fields to give talks at meetings of the District Medical Societies on subjects of interest and importance to all practitioners. It is a pleasure to announce that a similar arrangement has been made this year and that the gentlemen named below are willing, without expense to the District Society, to give occasional talks of thirty to forty minutes on subjects relating to the promotion of public health, extending opportunity for questions and discussion. It is suggested that medical societies consider meeting at neighboring public institutions, since such meetings have been most successful in the past, particularly at the tuberculosis sanatoria and state hospitals for the insane.

José Penteado Bill, M.D., Doctor of Public Health.
Specialty: Preventive Medicine.

Frank C. Dunbar, M.D., Bacteriologist, Instructor in Bacteriology and Pathology, Tufts College Medical School.

Walter E. Fernald, M.D., Superintendent, Massachusetts School for the Feeble-minded.

Timothy Leary, M.D., Professor of Pathology, Tufts College Medical School; Medical Examiner, Suffolk County.

Edwin H. Place, M.D., Physician-in-Chief, South Department, Boston City Hospital. Specialty: Contagious Diseases.

C. Morton Smith, M.D., Chief of Department of Syphilis, Massachusetts General Hospital.

George Gilbert Smith, M.D., Assistant in Department of Genito-Urinary Diseases, Massachusetts General Hospital. Specialty: Genito-Urinary Diseases.

Leslie H. Spooner, M.D., on Staff of Out-Patient Department, Massachusetts General Hospital. Specialty: Specific Diagnosis and Treatment of Pseudo-syphilis.

William C. Woodward, M.D., Health Commissioner, City of Boston.

George H. Wright, D.M.D., Lecturer on Dental Hygiene, Harvard Dental School. Specialty: Dental Surgery.

Secretaries of District Medical Societies writing to ask for these lecturers will kindly designate the topic, the place and the hour of meeting as well as the name of the desired speaker, thus eliminating unnecessary correspondence. Please address communications to the Secretary of the Committee, Annie Lee Hamilton, M.D., 164 Longwood Ave., Boston 17.

SOCIETY NOTICE.

THE ANNUAL MEETING OF THE PROCTOLOGICAL SOCIETY.—To those who are not particularly interested in proctology the diagnosis and treatment of rectal disorders appears to be concerned chiefly with the three or four conditions which we meet so frequently in the clinic. A perusal of the program of the Twenty-Second Annual Meeting of the Proctological Society, held in Boston on June 3, 4 and 6, 1921, shows a wide variety of pathology and suggests that there are right and wrong ways of managing the problems in this field, as well as in every other.

Among the papers read at this meeting, the following might prove of interest to the general practitioner:

Dr. Dooly C. Hawley, Burlington, Vt., writing on Hypertrophy of the Anal Papillae, described the symptoms of this condition as a sense of uneasiness in the rectum, disagreeable pressure, pain, spasmodic contraction, and hypertrophy of the sphincter muscle. The treatment consists in removing the papillae, preferably with scissors.

Dr. Emmet H. Terrell, Richmond, Va., uses quinine and urea hydrochloride in the treatment of simple chronic internal hemorrhoids, and in this type of case finds it very efficacious.

Dr. Alfred J. Zobel, San Francisco, Calif., writes of the value of properly administered enemata and colonic irrigations and points to the fact that there are very few nuffies who are able to give these treatments correctly.

Dr. William H. Axtell, Bellingham, Wash., refers to separation of the recti muscles as a causative factor in the production of ptosis of colon and sigmoid and fecal stasis.

Dr. Curtis C. Meehling, Pittsburgh, Pa., reports a case of tuberculoma of the ischio-rectal fossa.

Dr. Samuel G. Gant, New York, N. Y., writing of the relation of pulmonary and ano-rectal tuberculois to fistula-in-ano says that of 5000 fistulae operated on by him, less than 10% were tuberculous. Even when tuberculous, these fistulae are curable by operation and sometimes by treatment with mild stimulants such as 10% methylene blue. He always employs local anesthesia when operating on these cases.